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THE THREE NEW BATTLESHIPS for which bids are soon to be called for by the Navy Department are to have the following dimensions: Length, 368 ft.; breadth, 72 ft.; mean draft, 23½ ft.; displacement, 11,500 tons; coal capacity, loose storage, 1,200 tons. The side armor is to have a maximum thickness of not less than 16½ ins. and an average breadth of 7 ft. 6 ins., extending from the stem to the after barbette and tapering from the maximum thickness over the engine and boiler spaces to a uniform thickness of 4 ins. forward. The barbettes for the 13-in. guns are to have walls 15 ins. thick except in the rear, where they may be reduced to 10 ins. The turret armor will be 14 ins. thick. The sides from the armor plate to the main deck will be protected by not less than 5½ ins. of steel armor, and the protective deck is to be 2¾ ins. thick on its flat surface and from 3 to 5 ins. on its slope. The power will be supplied by two vertical triple-expansion four-cylinder engines, driving twin screws. The batteries will consist of four 13-in. guns in barbette turrets, ten 6-in. rapid-fire guns in broadside on the main deck and four on the upper deck, and a secondary battery of 24 smaller rapid-fire and machine guns. There will be two submerged torpedo tubes. The vessel will be accepted from the contractor if her speed is 16 knots or more, but for speeds of less than 16 knots penalties will be assessed of $25,000 per quarter knot deficiency from 16 to 15½ knots, and $50,000 per quarter knot deficiency under 15½ knots. Comment on these vessels is made elsewhere in this issue.

DRY DOCK NO. 3, IN THE BROOKLYN NAVY YARD, is reported to be still leaking to some extent, but it is expected that it will soon be ready for use. As dry dock No. 2 also needs extensive repairs, after seven or eight years' use, this is particularly desirable. Secretary Long is about to order the court martial of U. S. G. White, C. E., U. S. N., on charges growing out of the Menocal court martial on dry dock No. 3. Washington despatches also say that proceedings are to be at once instituted against John D. Crimmins, of New York, and Ralph C. Packard, of Morristown, N. J., bondsmen of Contractors John and Augustin Walsh, to recover a large amount of money lost by the government in connection with this dock.

THE "HORATIO HALL," of the Maine Steamship Co., had a trial trip on June 17 from Portland, Me., to New York, making the trip in 18 h. 45 m. This steamer was built at the Roach shipyard, at Chester, Pa. She is 319 ft. 4 ins. long, 46 ft. beam and 19½ ft. deep. The cost was over $350,000.

THE "CITY OF ERIE," just completed by the Detroit Dry Dock Co. for the Cleveland & Buffalo Transit Co., is a steamer intended to run between Cleveland and Buffalo and a sister ship of the "City of Buffalo," of the same line. The "City of Erie" is 324 ft. long, 76 ft. wide over all and 18 ft. molded depth. She is fitted with six boilers 12 ft. 6 ins. diameter and 11 ft. 6 ins. long, equipped with Howden hot draft and designed for 130 lbs. steam pressure. The engines are of the compound, beam condensing type, with 52-in. high-pressure cylinder, 8-ft. stroke, and low-pressure cylinder 80-ins. diameter and 12-ft. stroke. The Fuller Co. has furnished an electric light plant of 800 16-c. p. lights, with two direct connected dynamos. There are 97 staterooms on the promenade deck, including six parlors, and 64 staterooms on the gallery; accommodations for 50 second-class passengers are provided on the orlop deck. The ship is ventilated throughout by the McCreery ventilating system.

A FIVE-MASTED SCHOONER, with a coal-carrying capacity of 4,000 tons, is being built at Camden, Mass., by H. M. Bean. The length over all will be 325 ft. and 274 ft. on the keel.

THE TWO NICARAGUA CANAL COMPANIES, the Maritime Canal Co. of Nicaragua, and the Nicaragua Canal Construction Co., held special separate meetings lately to consider the subject of submitting to the government a definite proposition regarding the construction of the canal, with statements of outstanding obligations of the two companies, in accordance with a resolution of the U. S. Senate of May 16.

THE NICARAGUA CANAL PROJECT was before the Senate Committee lately, and Rear Admiral Walker, Chairman of the existing Nicaragua Canal Commission, testified that, while the plans and estimates were not completed, he was convinced that the plan for a canal along the proposed route was entirely feasible, and that the canal could be built at a cost of about $125,000,000. A few days later Prof. L. M. Haupt, also a member of the Commission, also gave testimony before the committee, and set the probable cost of the canal at $90,000,000 to $95,000,000. It seems fair to conclude from the slight discrepancy of $35,000,000, more or less, between the two estimates, that the Commission itself does not know yet what the canal will cost.

A NICARAGUA CANAL BILL was reported to the Senate on June 20 by Senator Morgan as a substitute for his bill amending the act of 1880 incorporating the Maritime Canal Co., of Nicaragua. This last bill provides that all outstanding stock be called in and cancelled except that held by Nicaragua and Costa Rica; then 1,100,000 new shares of $100 each are to be issued, and 700,000 of these are to be turned over to the government in return for an issue and guarantee of interest of bonds not exceeding $100,000,000 in amount, at 3% interest. The government is to have a first lien on all property, and $4,500,000 of the guaranteed bonds are to be used to liquidate existing cash liabilities, contract obligations and reimbursements for expenditures already incurred. The canal is to be built under officers of the U. S. Engineer Corps, and the bonds will be issued by the Treasury Department, at not less than par, in payment as work progresses. The cost of the canal is limited to $115,000,000, and the work is to be finished in six years. The President of the United States will appoint the directors; the neutrality of the canal is guaranteed to all nations, but this government may at all times protect it against interruption as a necessary means of communication between the eastern and western coasts of the United States. The Maritime Canal Co. reports its expenditures up to June 4, 1898, as follows: Preliminary expenses incident to procuring concessions, $280,000; surveys, plant, construction, navigation rights and land, $4,287,736; administration and care of property, $268,692; estimated cash obligations, $300,000; total, $5,136,428. The bond and stock obligations are as follows: Bonds for work done, $6,855,000, less $518,000 bonds taken in liquidation; stock sold, $1,014,500; stock paid for concessions, $12,000,000; issued to Nicaragua, $6,000,000; to be issued to Costa Rica, $1,500,000; stock paid for work, $2,957,000; total stock obligations, $23,471,500.

THE MOST SERIOUS RAILWAY ACCIDENT of the week occurred on the Norfolk & Western Ry. about two miles west of Shawsville, Va., on June 19. Passenger train No. 4 while running down-grade jumped the track at the entrance of a cut. Three persons were killed and several injured. The accident is said to have resulted from the breaking of a wheel flange on the locomotive truck.

THE EXPLOSION OF A LOCOMOTIVE BOILER on the Iron Railway at Ironton, O., on June 14, resulted in the death of the engineman, the serious injury of two men and the slight injury of two others. The engine and two cinder cars were standing half way up the incline when the explosion occurred.

A LAUNCHING ACCIDENT occurred at Blackwall, England, on June 21, during the launching of the new British battleship "Albion." The great displacement of the 12,950-ton hull caused an immense amount of water to rise on all sides, completely submerging one of the low stages upon which was a large crowd of people. Of the number some 30 were drowned, while many others were injured by the floating wreckage.

THE WALLABOUT CHANNEL, in New York harbor, is to be improved to the extent of providing a channel 20 ft. deep and 300 ft. wide, from its entrance to the timber causeway, in Brooklyn. This improvement will provide increased ferry accommodations and enable commerce to be better handled at the wharves.

THE MISSISSIPPI RIVER COMMISSION held its annual meeting on June 19, in New York city, at the office of its President, Gen. George L. Gillespie, Engineer Corps, U. S. A. The members present were Lieut.-Col. Amos Stickney and Major Thos. H. Handbury, Engineer Corps, U. S. A.; Mr. B. M. Harrod and Mr. Henry Flad, both Past Presidents of the American Society of Civil Engineers; Mr. Robert S. Taylor and Mr. Henry L. Marindin, of the U. S. Coast and Geodetic Survey. A number of Congressmen and engineers of the levee districts appeared before the Commission to make reports and advocate measures. The annual report of the Commission was adopted, and an allotment was made for the various levee districts, supposed to amount to about $2,000,000.

LOUISIANA LEVEE STATISTICS are given as follows in the last report of the Board of State Engineers: The ten levee districts of the state embrace an area of about 9,500,000 acres, of which about 1,500,000 acres may be classed as cultivated land. During the overflow of 1882 about 75% of this area was submerged; in 1897 only about 15% was submerged. In 1882 the length of levee line in Louisiana and Arkansas, affecting Louisiana on the Mississippi River and interior streams, was about 1,165 miles; in 1897 this levee line was 1,278 miles long. The cubic contents of the levee line in 1882 and 1897 were about 32,000,000 and 96,000,000 cu. yds., respectively. There were lost by changes of location, necessitated by caving banks and crevasses, about 22,000,000 cu. yds. between 1882 and 1897. In the high water of 1882 there were about 82 crevasses, with an aggregate width of 34.4 miles; in 1892 there were 52 crevasses aggregating 6.33 miles in width, and in 1897 there were 12 crevasses with a total width of 1.75 miles. The total amount and cost of levee work in Louisiana, and in Arkansas as affecting Louisiana, from 1865 to 1897, is given as follows:

	Cu. yds.	Cost.
By state and state levee districts.	75,080,878	$21,069,988.53
By U. S. Gt., comencg. in 1882.	35,726,288	6,338,122.17
Total	110,807,158	$27,408,110.70

THE NILE RESERVOIRS are referred to in Lord Cromer's annual report upon Egyptian affairs. A contract was made on Feb. 20, 1898, between the Egyptian government and Messrs. Aird & Co., of England, for the building of locks and dams at Assuan and Assiut and the Ibrahimieh canal, with regulator and lock, for the sum of $10,000,000. This contract is to be completed in five years from July 1, 1898, and the Egyptian government is to make payments half-yearly extending over a period of 30 years. Lord Cromer says there is crying need for the increase of the water supply, and this expenditure will increase an equally needed revenue. The measure is warmly approved by the Egyptians.

THE AMERICAN-ASIATIC ASSOCIATION was organized at the New York Chamber of Commerce on June 16. The purposes expressed in its constitution are: To foster and safeguard the commercial interests of the United States in China, Japan, Corea, the Philippine Islands and elsewhere in Asia or Oceanica; to secure the advantages of permanent organization in all matters connected with Asiatic trade, or legislation or treaties effecting the same; to provide for the gathering and distribution of useful information to its members, and to generally promote association among those interested in trade in these sections of the world. Mr. Everett Frazer is the first President; Mr. S. D. Brewster, Vice-President; J. R. Patterson, Treasurer, and John Foord is Secretary. The enrolled members already include representatives of some of the most prominent houses in New York, Philadelphia, Washington and Washington. Any one of full age interested in present or future business in Asia is eligible for membership.

AMERICAN LUMBER EXPORTS are on the increase, as shown by returns for the last two years. During 1895 the value of lumber exports was $30,000,000, during 1896 $33,000,000 and for 1897 there was an increase of 20%, bringing the total up to $40,000,000.

A FORM OF RECTANGULAR COTTON BALE recently adopted by several cotton buyers' associations in Texas is 54 ins. long by 24 ins. wide. A density of 39½ lbs. per cu. ft. is used against 22½ lbs. required by the maritime associations; 100 of these bales weigh 56,720 lbs. and can be loaded in a standard freight car. The ordinary rate from Galveston to Havre, France, is 46 cts., and to Liverpool 37 cts. The rate for the new bales is 28 cts. to Havre and 23½ to Liverpool.

AN EXTENSIBLE TIMBER TRUSS TRENCH BRACE.

The so-called "extensible brace" has so effectually proved its usefulness in sewer and water-pipe trench work that nothing needs to be said at this late day respecting its advantages. In the accompanying view, however, we show a new form of trussed timber extensible brace, or "double camber" brace, as its designer terms it, which has recently been used quite extensively in excavating some deep sewer trenches in Washington, D. C., and which seems to offer considerable economy in timber and saving in weight where very long braces have to be employed. The illustration shows the brace improperly placed owing to a mistake of the workmen, its proper position being with the main chord planks vertical or edges up. The view also shows a section of trench about 47 ft. deep and 25 ft. wide at the top. For these dimensions the braces were built of two 3 × 12-in. plank braced together by a 3 × 12-in. spacing block at each end and five intermediate struts also of 3-in. plank. The extensible end bearings or castings were of the standard form made for 9 × 12-in. solid timbers by the Dunn Manufacturing Co., Pittsburg, Pa. Complete and ready to be placed in the trench, the cost of each brace was a fraction over $10. The trussed timber extensible brace was designed for this work by Mr. J. K. Murphy, of the firm of J. K. Murphy & Brother, General Contractors, Washington, D. C., and a patent has been applied for. We are indebted to the designer and to the Dunn Manufacturing Co., of Pittsburg, Pa., for the information from which this description has been prepared.

VIEW SHOWING TRUSSED TIMBER EXTENSIBLE TRENCH BRACE EMPLOYED IN WASHINGTON, D. C., DEEP SEWER WORK.

J. K. Murphy, Washington, D. C., Inventor.

THERMAL TESTS FOR CAR WHEELS.*

By S. P. Bush.†

There are in service in the United States and Canada at the present time, approximately, 9,750,000 cast-iron car wheels, costing in round numbers $58,500,000. There are produced and put into service in this territory each year, approximately, 1,100,000 car wheels, at an estimated value of $6,600,000. At the last convention of this Association one of the members presented some facts concerning the breakage of cast-iron wheels, and these facts being taken from authentic records, it will not be out of the way to quote them again. There were removed during a period of four years and four months on the division of the Pennsylvania Railroad, from Pittsburg to Philadelphia, a grand total of 7,180 wheels, on account of being either cracked or broken, 6,446 being cracked and 250 being broken. The wheels removed comprised those produced by almost every manufacturer in the United States, and it can be safely stated that practically all cast-iron wheels are subject to cracking or breaking when subjected to service with which they are likely to meet on many of the railroads of the country. A careful examination of these wheels indicated that they were cracked or broken principally by the expansion of the rim, or because of internal strains, coming as a result of imperfect manufacture, so great as to produce rupture when in service.

That these facts hold good to the same, or less, extent on other roads there is no reason to doubt, and certainly with such facts before us it is not out of the way to conclude that such failures should be eliminated, if it is possible to do so. During the past three years it has been fully demonstrated that cast-iron wheels can be produced which will resist satisfactorily the destructive force of sudden expansion of the rim, and which will not possess, to any material extent, internal strains. This has been demonstrated by actual service, and also by means of a test designed to reproduce, in a measure, the conditions of service, now commonly known as the thermal test. When first introduced this test was thought to be unnecessarily severe, and did not represent the conditions of service. The fact, however, that most manufacturers at the present time have no difficulty in producing wheels to comply with this part of the specifications, with but a small increase in cost, would rather indicate that it is quite practicable, even though it does not reproduce exactly the conditions of service. The question naturally arises whether any necessary qualities of the car wheel are thereby impaired. The opinion has been expressed by a few that if wheels are produced so as to withstand the thermal test, the wearing quality, or mileage life, will be very materially reduced. This assertion is based on the belief that that quality in a car wheel which produces strength is in a very large measure opposed to those qualities which produce durability of the tread and flange. To put this difference in quality more specifically, it might be stated that the wheel which is said to produce a greater durability of tread and flange contains a greater proportion of combined carbon, while the wheel that is best adapted to withstand the thermal test has a larger percentage of graphitic carbon.

Through the General Superintendent of Motive Power of the Pennsylvania R. R., Mr. F. D. Casanave, and the Chemist of that road, Dr. C. B. Dudley, I am able to present the following facts bearing on this point. Twenty wheels were selected from those in service, representing some of the principal makes of the country, all of which were subjected to the thermal test, 10 passing it successfully and 10 failing. Chemical analyses were made of the iron of which these 20 wheels were made, two sets of samples being taken, one from the body, or gray iron, and the other from the chill. The result of these analyses are given in the accompanying tables.

The figures cover determinations actually made. It was not deemed essential to determine the phosphorus, silicon and manganese in the chills, as there was no reason to think that they would differ in proportion from the same elements in the gray iron. In reality all borings for the two analyses were obtained not over 3 or 4 ins. apart in the same wheel, the one being from the gray iron in the plate and the other from the chill. It is well known that the difference between chilled iron and gray iron in the same casting is in the condition of the carbon. It will be noted that in the gray iron the graphite is pretty well toward 3%, and that the combined carbon is toward 1%, while in the chill the figures are reversed, the variations being not far from one-half of 1%. The figures giving the analyses of the gray iron are given for a comparison and as a matter of information.

The main point in these analyses, to which special attention is called, is the close agreement in the composition of the chills of these different wheels. If we take the averages of those that did and those that did not stand the thermal test, we find as follows:

	Total carbon.	Graphitic carbon.	Combined carbon.
Average of wheels which stood the thermal test	3.81	0.42	3.31
Average of wheels which did not stand thermal test	3.73	0.42	3.31

It will be noted that the graphitic carbon is the same in both cases, and that the combined carbon only differs 0.08%. Furthermore, the general agreement of the combined carbon of the chills in wheels from different makers is very noticeable and very remarkable. It is difficult to see how any other conclusion can be drawn from these figures than that there is no evidence, so far as the chemical composition is concerned, to show that the chills of wheels which stand the thermal test differ in their physical properties, so far at least as the physical properties depend on the chemistry of the metal, from the chills of wheels which do not stand the thermal test. Also, it seems fair to conclude that wheels made in different parts of the country and by different manufacturers do not differ very widely so far as chemical composition of the chills is concerned. It is quite obvious why this should be so, since the chill fixes the chemical composition within very narrow limits. Therefore, to emphasize what has been stated previously, it seems reasonable to conclude that the wear of wheels depends on the chill, and if chills of various wheels are as closely alike as these analyses show them to be, there is really no evidence that the wear of these chills will differ to any appreciable extent.

Referring now to the manner of conducting the thermal test. The method now used may be criticised to some extent, and justly too, on the ground that it cannot be applied with absolute uniformity at all times and at all places—that is to say, in pouring the ring of molten metal around the rim of a wheel, it is difficult, if not almost impossible, to have the iron always at exactly the same temperature, so that in some cases the test will be a little more severe, and in others a little less. The test recommended by the committee of the Association last year requires that this ring of metal be poured at a temperature as low as possible without producing seams or wrinkles. It is, of course, difficult to say exactly when the iron is at such a temperature, but it is believed that the foreman in charge of most wheel foundries is so experienced as to be able to tell very closely from the appearance when the iron has arrived at this temperature before pouring.

The writer has communicated, concerning the thermal test, with nearly all of the principal wheel manufacturers of the country, and they have been asked to suggest a method that will be more accurate. They have all given the matter considerable attention, and up to the present

Table Showing Analyses of the Gray Iron in Wheels, Which Stood Thermal Test.

Carbon						
Total.	Graphitic.	Combined.	Manganese.	Phosphorus.	Silicon.	Sulphur
3.68	3.00	0.68	0.64	0.30	0.56	0.11
3.54	2.74	0.80	0.28	0.47	0.65	0.10
3.50	3.48	0.02	0.35	0.40	0.45	0.13
3.65	2.41	1.24	0.31	0.53	0.57	0.16
3.73	2.89	0.84	0.83	0.38	0.50	0.11
3.63	3.03	0.60	0.44	0.43	0.56	0.12
3.67	2.70	0.97	0.24	0.38	0.53	0.10
3.67	3.03	0.64	0.32	0.42	0.47	0.16
3.64	2.53	1.11	0.33	0.50	0.62	0.12
3.86	3.31	0.55	0.30	0.36	0.63	0.11

Table Showing Analyses of Gray Iron in Wheels, Which Did Not Stand Thermal Test.

Carbon						
Total.	Graphitic.	Combined.	Manganese.	Phosphorus.	Silicon.	Sulphur
3.64	2.41	1.23	0.30	0.35	0.71	0.14
3.22	1.98	1.24	0.34	0.51	0.77	0.16
3.51	2.56	0.95	0.31	0.44	0.75	0.12
3.64	2.30	1.34	0.21	0.39	0.65	0.13
3.61	2.52	1.09	0.17	0.35	0.60	0.11
3.61	2.94	0.67	0.33	0.42	0.79	0.12
3.73	2.60	1.13	0.23	0.35	0.66	0.11
3.68	2.54	1.14	0.19	0.39	0.88	0.12
3.74	2.57	1.17	0.30	0.41	0.60	0.13
3.45	2.39	1.06	0.40	0.36	0.68	0.19

Table Showing Analyses of the Chilled Iron in Wheels Which Withstood and Failed Under Test.

Stood thermal test.			Did not stand thermal test.		
Total carbon.	Graphitic carbon.	Combined carbon.	Total carbon.	Graphitic carbon.	Combined carbon.
3.90	0.43	3.47	3.90	0.34	3.56
3.71	0.32	3.39	3.37	0.32	3.05
3.73	0.42	3.31	3.71	0.43	3.28
3.70	0.55	3.15	3.75	0.78	2.97
3.87	0.41	3.46	3.74	0.49	3.25
3.77	0.55	3.22	3.77	0.30	3.47
3.84	0.35	3.49	3.86	0.48	3.38
3.84	0.40	3.44	3.80	0.41	3.39
3.71	0.49	3.22	3.82	0.29	3.53
4.01	0.30	3.71	3.56	0.36	3.20

*Abstract of a paper presented at the Saratoga, N. Y., convention of the Master Car Builders' Association, June 17, 1898.

†Superintendent of Motive Power, P., C., C. & St. L. Ry., Columbus, O.

time have been unable to develop any plan that would be any more satisfactory and still thoroughly practicable.

The every-day use of the present thermal test has demonstrated its extreme simplicity, and with the one exception of possible variation in the temperature of the molten metal, it seems admirably adapted to the main purpose. As previously stated, the object of such a test is to produce conditions more severe than those of service, so that it may be known what margin of safety can fairly be counted on beyond. As to the magnitude of variation in the temperature of molten metal used for the test, it is believed that undue significance has been attached to this, and that there is a growing feeling that it is so inconsiderable as to give practical uniformity.

The great majority of the wheelmakers of the country state that there is no difficulty in producing wheels which will stand the present test, and that the test itself is satisfactory. This being the case, and in view of the facts here given, it would seem that the thermal test ought to commend itself to users of wheels as a satisfactory way to the purchase of that which is desired with all the certainty possible, viz., safety.

In conclusion, it may be again said that there is up to the present time no reason to believe that in obtaining greater safety, durability is sacrificed; on the contrary, all of the evidence thus far obtainable goes to show that decreased durability is not to be expected; in fact, one of the most prominent manufacturers in the country is making wheels for special purpose of obtaining toughness, and states his ability to prove even a higher mileage life.

MINERAL PRODUCTION OF THE UNITED STATES DURING 1897.

The "Engineering and Mining Journal," in its issue of May 25, publishes an interesting table, which we reprint herewith, giving the quantity and value of the mineral products of the United States for the years 1896 and 1897, as compiled for the sixth annual volume of "Mineral Industry," which will shortly appear. The mineral and metal production of the United States in 1897, according to these figures, was the largest in the history of this or any other country; it almost equals in value the production of all Europe. The economic details published in "The Mineral Industry" show that the United States is rapidly attaining the point where it will be the greatest exporter of minerals and metals of all the commercial nations.

The total value of the mineral production of the United States in 1897 was $746,230,982, against $737,958,761 in 1896. The values given are generally at the mine or works; but with a few of the principal metals—such as lead, copper or zinc—this is not possible, and their values are taken at the leading markets.

The total value of the output in 1896 exceeded that of the mineral and metal production of all Continental Europe, and nearly doubled that of the United Kingdom, the value of whose mineral output in 1896 was, in round figures, about $340,000,000, while that of Germany was about $300,000,000, that of France about $110,000,000, and that of Belgium $100,000,000.

In the table there is necessarily some duplication, quantities and values being given of some of the raw materials which are used in making other products; thus bauxite used in making aluminum, iron ore used in making pig iron, coal used in coke, and a few other things.

Deducting these necessary duplications, the total value of our production in 1897 reached the sum of $678,966,644.

This output is limited entirely to ores and other substances mined in the United States and to metals reduced from these ores. In addition there was also a large quantity of metals reduced or refined in this country from imported ores or base bullion. These are chiefly sent here for treatment from Canada and Mexico. The total production of this class reported was 584,983 oz. gold; 40,218,776 oz. silver; 26,938,254 lbs. copper; 4,099,390 lbs. nickel; 92,117 short tons lead; the total value of these metals being $47,127,174. This output of our metallurgical works is altogether additional to that recorded in the table.

MINERAL PRODUCTION OF THE UNITED STATES IN 1897–S.

Compiled for THE MINERAL INDUSTRY, Vol. VI.

By Richard P. Rothwell, editor of the *Engineering and Mining Journal*.

Number.	Products.	Customary Measures.	1896. Quantity. Customary Measures.	1896. Quantity. Metric Tons.	1896. Value at Place of Production. Totals.	1896. Value at Place of Production. Per M. Ton.	1897. Quantity. Customary Measures.	1897. Quantity. Metric Tons.	1897. Value at Place of Production. Totals.	1897. Value at Place of Production. Per M. Ton.
	NON-METALLIC.									
	Abrasives:									
1	Carborundum	Sh. T.	505	539	$365,612	*f*$0.68	621	563	$153,812	*f*$0.27
2	Corundum	Sh. T.	250	227	35,000	154.19	230	209	362,300	154.07
3	Crushed steel	Sh. T.	326	296	50,624	171.00	324	294	51,874	176.00
4	Diatom. earth	Sh. T.	3,540	3,211	34,200	10.65	3,000	2,721	30,400	11.17
5	Emery	Sh. T.	1,550	1,406	108,500	77.17	1,500	1,361	105,000	77.15
6	Garnet	Sh. T.	2,440	2,214	85,400	38.57	2,260	2,050	79,100	38.57
7	Grindstones	Sh. T.	31,301	28,396	294,338	10.36	36,651	33,250	366,675	11.00
8	Pumice	Sh. T.	*Nil.*				1,700	1,542	8,500	5.51
9	Quartz crystal	Sh. T.	6,000	5,432	16,500	3.04	6,000	5,432	16,500	3.04
10	Tripoli	Sh. T.	1,405	1,275	4,823	3.79	1,631	1,479	5,475	3.70
11	Whetstones				105,201				80,920	
12	Alum	Sh. T.	14,090	12,782	422,700	33.07	15,456	14,021	463,680	33.07
13	Aluminum sulphate	Sh. T.	42,240	38,319	1,056,000	27.56	46,355	42,053	1,158,875	27.56
14	Ammonium sulphate	Sh. T.	257	233	10,280		3,111	2822	124,440	
15	Asbestos	Sh. T.	716	650	12,670	19.49	770	698	15,400	22.06
16	Asphalt	Sh. T.	20,414	18,519	362,590	19.58	27,397	24,854	486,620	19.58
17	Asphaltic limestone	Sh. T.	5,000	4,536	55,000	12.12	2,390	2,168	11,450	5.28
18	Bitumin's sandstone	Sh. T.	51,956	47,134	132,500	2.81	41,185	37,363	125,555	3.36
19	Barytes	Sh. T.	21,900	19,867	87,600	4.41	27,316	24,781	109,264	4.41
20	Bauxite	L. T.	17,096	17,369	42,740	2.46	20,500	20,919	41,180	1.97
21	Borax (crude)	Sh. T.	13,330	12,084	296,400	22.04	19,400	17,599	388,000	22.05
22	Bromine	Lb.	559,285	253	143,074	*j*0.57	487,149	221	136,402	*j*0.62
23	Calcium carbide	Sh. T.	890	780	48,000	61.54	1,925	1,746	134,750	77.17
24	Cement, nat. hydraul	Bbls*a*	7,407,311	1,007,980	4,385,962	4.35	7,781,377	1,058,883	4,127,124	3.90
25	Cement, Portland	Bbls*b*	1,577,283	286,181	2,502,479	8.74	2,272,971	412,405	3,521,480	8.54
26	Cement, slag	Bbls*c*	*Nil.*				40,000	6,350	60,000	9.45
27	Chrome ore	L. T.	702	713	7,775	10.90	50	51	550	10.78
28	Clay products	Sh. T.			65,000,000				*q*60,000,000	
29	Coal, anthracite	Sh. T.	48,133,930	42,667,101	86,682,794	2.03	52,645,133	47,759,095	85,857,717	1.79
30	Coal, bituminous	Sh. T.	139,468,559	126,525,967	113,401,602	0.89	147,557,980	133,864,509	120,505,982	0.89
31	Coal, cannel	Sh. T.	54,661	49,588	146,491	2.95	56,511	51,267	153,145	2.98
32	Coke	Sh. T.	10,309,015	9,400,770	17,311,823	1.84	12,742,340	11,562,073	23,307,879	2.02
33	Cobalt oxide	Lb.	12,925	*j*5,817	17,314	*j*2.98	19,300	*j*8,754	32,810	*j* 3.75
34	Copperas	Sh. T.	11,170	10,133	52,602	5.19	11,924	10,818	56,563	5.23
35	Copper sulphate	Lb.	48,732,840	22,150	1,953,225	88.18	51,012,945	23,139	2,040,518	
36	Feldspar	L. T.	24,907	25,305	124,251	4.91	20,900	21,234	113,773	5.36
37	Fluorspar	Sh. T.	6,000	5,432	48,000	8.83	9,025	8,187	74,456	9.09
38	Fullers earth	Sh. T.	11,326	10,275	68,476	6.66	17,049	15,467	91,634	5.93
39	Grahamite (*k*)	Sh. T.	1,282	1,163	38,460	33.07	1,756	1,592	52,680	33.09
40	Graphite, crystalline	Lb.	405,006	*j*183,709	18,225	*j*.10	993,138	*j*450,487	44,691	*j*.10
41	Graphite, amorphous	Sh. T.	574	520	3,850	7.40	1,200	1,090	11,400	10.45
42	Gypsum	Sh. T.	195,553	177,405	583,136	3.29	223,061	202,360	711,952	3.52
43	Iron ore	L. T.	16,000,056	16,256,057	31,200,880	1.93	18,316,997	18,610,038	31,138,844	1.67
44	Litharge	Sh. T.	6,500	5,897	540,300	91.57	9,800	8,891	899,100	100.11
45	Magnesite	Sh. T.	2,067	1,875	9,715	5.12	1,907	1,730	7,628	4.41
46	Manganese ore	L. T.	162,526	165,126	339,083	2.05	156,787	159,296	332,700	2.09
47	Mica, ground	Sh. T.	570	517	9,686	18.73	2,692	2,442	38,218	15.65
48	Mica, sheet	Lb.	17,630	*j*7,997	12,528	*j*1.57	92,335	*j*41,883	45,615	*j* 1.09
49	Mineral wool	Sh. T.	5,853	5,309	61,614	11.60	5,007	5,141	45,494	8.81
50	Monazite	Lb.	17,500	8	875	109.37	40,000	18	2,000	111.11
51	Natural gas				10,000,000				10,000,000	
52	Paints, metallic	Sh. T.	31,865	28,908	342,167	11.15	36,293	32,925	370,594	11.26
53	Paints, ocher, etc	Sh. T.	17,835	16,179	178,793	11.05	11,151	10,116	110,165	10.89
54	Paints, venetian red	Sh. T.	5,998	5,309	93,586	17.62	4,586	4,160	55,030	10.96
55	Paints, white, red ld.	Sh. T.	95,955	87,049	7,856,310	90.39	103,295	93,654	9,291,150	99.21
56	Paints, zinc oxide	Sh. T.	15,863	14,391	1,189,725	82.67	26,262	23,825	2,100,960	88.18
57	Petroleum (crude)	Bbls*d*	55,254,795	7,730 425	65,753,206	8.50	56,985,643	7,972,579	44,804,962	5.62
58	Phosphate rock	L. T.	937,372	952,370	2,812,116	2.95	906,080	920,577	2,718,240	2.95
59	Precious stones				200,000				101,000	
60	Pyrites	L. T.	109,282	111,030	292,626	2.63	128,468	130,523	379,699	2.83
61	Salt	Bbls*e*	15,707,908	1,995,017	5,328,250	2.67	13,153,524	1,670,592	4,859,364	2.91
62	Silica, sand & quartz	L. T.	720,399	731,925	1,076,038	1.47	750,000	762,000	1,125,000	1.48
63	Slate, roofing	Sq'es.	699,100		2,260,862	*n*3.23	895,372		2,695,580	*n*3.01
64	Slate, manufactures				467,578				547,645	
65	Soapstone	Sh. T.	14,350	13,018	143,500	11.02	18,974	17,213	189,740	10.91
66	Soda, natural	Sh. T.	3,000	2,722	65,000	23.88	5,000	4,536	110,000	24.25
67	Soda, manufactured	M. T.		157,475	3,621,925	23.00		277,072	5,774,656	20.84
68	Stone, for building				30,599,894				30,040,000	
69	Stone, limestone (flux)	L. T.	3,794,175	3,854,882	1,669,437	0.43	4,247,688	4,315,651	1,898,983	0.43
70	Strontium sulphate	Sh. T.	*Nil.*				40	36	200	5.55
71	Sulphur	L. T.	3,800	3,861	72,200	18.70	1,600	1,717	34,814	20.27
72	Sulphuric acid	Sh. T.	1,019,501	924,885	17,331,517	18.74	1,128,741	1,023,987	21,446,079	19.19
73	Talc, common	Sh. T.	7,098	6,439	63,585	9.87	9,563	8,675	82,795	9.54
74	Talc, fibrous	Sh. T.	51,816	47,007	256,080	5.45	58,836	53,376	288,185	5.39
75	Uranium ore	Sh. T.	*Nil.*				17	15	9,010	600.66
76	Zinc ore, exported	L. T.	2,324	2,361	47,408	20.08	9,251	9,399	211,350	22.48
77	Est. prod. unspecified				5,000,000				5,000,000	
	Total non-metals				484,999,181				481,635,147	
	METALS.									
78	Aluminum	Lb.	1,300,000	*j*589,676	$520,000	*j*$0.85	4,000,000	*j*1,814,400	$1,400,000	*j*$0.77
79	Antimony	Lb.	1,226,000	556	84,717	152.37	1,500,000	680	107,250	157.72
80	Copper (*m*)	Lb.	479,806,183	217,639	51,003,397	234.35	510,190,719	231,421	56,325,055	243.39
81	Gold	Oz. *f*	2,558,433	*j*79,576	52,886,209	*j*664.60	2,864,576	*j*89,092	59,210,795	664.60
82	Iron, pig	L. T.	8,623,127	8,761,097	91,577,610	10.45	9,652,680	9,807,123	92,077,312	9.45
83	Iridium	Oz.					20.25		606	
84	Lead, value at N. Y.	Sh. T.	174,792	158,479	10,411,643	54.07	197,718	179,398	11,784,093	65.73
85	Nickel	Lb.	17,170	*j*7,788	4,464	*j*0.57	33,700	*j*15,296	11,628	*j*0.76
86	Platinum	Oz. *f*	200	91	2,800	454.89	200	91	3,000	482.39
87	Quicksilver	Flks*g*	29,863	1,036	1,104,997	1066.58	26,079	905	991,002	1026.94
88	Silver, comm'l value	Oz. *f*	58,488,810	*j*1,819,208	39,245,992	*j*21.58	56,457,292	*j*1,756,004	33,755,815	19.22
89	Zinc	Sh. T.	77,637	70,432	6,117,796	86.86	100,387	91,070	8,271,889	90.83
	Total metals				252,959,670				264,538,485	
	Grand totals				737,958,806				746,173,632	

(*a*) Barrels of 300 lb.; (*b*) 400 lb.; (*c*) 200 lb.; (*d*) 42 gal.; (*e*) 280 lb. (*f*) Troy ounces. (*g*) Flasks of 76½ lb. (*h*) Bituminous coal includes brown coal and lignite. The anthracite production is the total for Pennsylvania, Arkansas, and Colorado. (*i*) Estimated. (*j*) Kilograms or per kilogram. (*k*) Including bitumen from Texas. (*m*) The value of the copper production is calculated at 0.25c. per lb. less than the average price of Lake copper at New York. (*n*) Value per square. (*p*) Value per cubic foot. (*q*) This figure is only approximate and will be revised.

Abbreviations: Sh. T., short tons (2,000 lb.); L. T., long tons (2,240 lb.); M. T., metric tons (2204.6 lb.); Sq'es, squares (100 sq. ft., lapped and laid).

A LIGHTHOUSE ON ROMER SHOALS, New York Bay, has been decided upon by the Lighthouse Board, and bids for its erection were opened on June 22 by Lieut.-Col. D. P. Heap, Engineer Corps, U. S. A. It is near the southeast side of the Swash Channel of New York Bay. The foundation of the tower, which is already built, consists of a cast-iron cylinder 30 ft. diameter, filled with concrete and extending 14 ft. above mean high water. For some time past this foundation has carried an iron skeleton frame supporting a lens lantern illuminated with Pintsch gas. This is now to be replaced by an iron lighthouse tower; circular in form; four stories high and furnished with a circular parapet and octagonal tower. The dwelling portion of the tower will be about 32 ft. high to the parapet floor, and 22 ft. diameter at the base. The shell will be made of iron plates, and all joints which are not planed will be packed with a hemp cord soaked in a mixture of red and white lead and linseed oil. This shell will be lined with brick laid in American Portland cement mortar; the first floor will be iron and the three upper floors will be of pine ⅞-in. thick, resting upon 2 × 4-in. yellow pine beams supported by the iron side-plates and spaced 16 ins. apart. When the tower is completed the foundation cylinder will be covered with two coats of coal tar to low-water mark, and all other iron work is to receive one coat of red lead ground in linseed oil, and two coats of paint, in linseed oil, of such color as the engineer may designate. This tower is to be finished by Sept. 1, 1898.

THE EFFICIENCY OF HIGH STEAM PRESSURES FOR LOCOMOTIVES.*

1. At the time this committee was appointed, it was expected that the experimental locomotive at Purdue University would serve to give sufficient data to permit the presentation of a report dealing entirely with experimental facts. Unexpected delays have been met and the problem has proven to be an extensive one. It has been thought best to withhold the experimental data thus far obtained until the investigations shall have developed definite conclusions. Some reference may, however, be made to the tendencies disclosed by the work already accomplished and a general discussion of the question may be introduced.

2. The locomotive with which the two Stephensons competed for and won the prize at Rainhill carried a steam pressure of 50 lbs. per sq. in. This was 70 years ago. Since the time of the Rocket, the pressure on locomotive boilers has been gradually increasing, and to-day practice in America involves the use of pressures which fall between the limits of 140 and 200 lbs. Few are now being built which are designed to carry less than 180 lbs., and a pressure of 200 lbs. has ceased to be uncommon.

3. Power and Efficiency.—The power developed by a locomotive is a function of pressure, steam distribution, diameter and travel of piston, and of speed. The efficiency is a measure of the degree of perfection attending the development of power. That engine is most efficient which, for each pound of coal burned, develops the largest amount of power in the cylinders.

Boiler efficiency depends upon the proportions of the boiler and the rate of power to which it is worked, while engine efficiency depends upon many factors of which initial pressure is but one. Whatever gain in efficiency is to be derived from the use of higher steam pressure in locomotives is, therefore, to be found in the improved performance of the engine. An ideal engine will always give increased efficiency in return for increase of pressure, but the actual engine may or may not do so.

Under normal conditions, a locomotive is worked so near its maximum power that the limit of power is determined by the amount of coal it can burn. If improvement can be had in the process of combustion, or in the more complete absorption of heat, or by a reduction in the amount of fuel lost as sparks, the efficiency of the boiler will be increased, and at the limit of power this improvement in performance can be converted into an increase of power. Again, if the cylinders can be made to better utilize the heat supplied them, they may with a given amount of steam be made to yield greater power. Anything which will operate to improve the efficiency of a locomotive may be employed as a means for increasing its power. If, therefore, increased pressure increases efficiency, it is clear that every interest will be served by its adoption.

4. Pressure a Single Factor Affecting Efficiency.—There can be no question but that the gradual increase of pressure which has been developing itself for many years past, has been accompanied by increased engine efficiency. It is, however, probably true that much of the improvement which has been observed is the result of betterments in mechanism, as well as of advance in the direction of pressure. This fact makes it desirable to emphasize at this point a matter to which brief reference has already been made, namely, that pressure constitutes but a single factor affecting the performance of an engine. Equally important with pressure are questions of valve proportions and of valve setting, of cylinder clearance, and of degree of expansion. Moreover, the significance of all of these factors is increased as the pressure is increased. Great improvement in efficiency, therefore, should not be expected as the result of attention given to the matter of pressure alone. On the contrary, it should be assumed that each increase of pressure is a demand for greater refinement in the mechanism of the engine. The valve action must be positive and must give a good distribution of steam at short cut-offs; the cylinder clearance must be minimum, the extent of surface bounding the clearance volume must be held to its lowest limits, and as pressures increase, compound cylinders must be used. With such attention to details, it is probable that each increase of pressure will be found to contribute its share to the progress of the future.

There are those who view the situation to-day with the feeling that increase of pressure, being rather easily obtained, has advanced more rapidly than other measures affecting the efficiency of the locomotive. They assert that time must be had in which to perfect other details before further advances in pressure are made. If this position is true, it is likely that, as in marine practice, an advance in boiler pressures awaits a general adoption of the water-tube boiler, so in locomotive practice a further advance in pressure awaits the more general advent of the compound engine.

It is frequently assumed that the process of gradually increasing pressure beyond limits now common will soon reach a point beyond which it will be found impracticable to go. Difficulties in maintaining a satisfactory condition of lubrication, in using soft metal packing, and in using water glasses under pressures which much exceed 200 lbs. are often cited in this connection. It would appear, however, from experience already had in marine work, that none of the difficulties are such as will block the way to the adoption of higher pressures whenever it shall be demonstrated that higher pressures are needed to further increase the efficiency of our locomotives.

5. High Pressure on Simple Locomotives.—The term "high pressure," as employed in this paragraph, refers to pressures above 160 lbs. The effect of such pressures on the performance of non-compound locomotives is now to be considered. The arguments for and against their adoption may be summarized as follows:

In Favor of Higher Pressures.	Against Higher Pressures.
1. Smaller cylinders and consequently lighter reciprocating parts.	1. Increased weight of boiler.
2. Reduced width of engine outside of cylinders.	2. Increased first cost of boiler.
3. Reduced first cost of engine.	3. Increased transportation charge, due to increased weight of boiler.
4. Reduced transportation charge because of reduced weight.	4. Probable increase in small heat losses, as from radiation and from leakage past valves and glands.
5. A possible gain in the efficiency of the engine, whereby a given power is developed on less steam and on less fuel than could have been done with a lower pressure.	

It is assumed that, other things being equal, the evaporative efficiency of the boiler will not be changed by such modifications as are necessary to enable it to withstand increase of pressure; the evaporative efficiency does not, therefore, appear as a factor on either side of the argument. It is assumed also that cost of lubrication and of repairs to boiler and engine do not necessarily change with changes in steam pressure.

The important factor favoring the adoption of higher pressure is the possible economy which is expected to result. The other advantages are incidental, and while some of them may have great weight in particular cases, their significance in the general case merits but slight attention.

The economy which is to result from an increase of pressure must be sufficient to balance all of the considerations which in the foregoing summary appear against the adoption of such pressures. Unless the gain in efficiency is material, the net result of increasing pressure will be disappointing.

In this connection it will be profitable to review briefly the results of tests run under different pressures on the experimental locomotive of Purdue University. This locomotive carries 250 lbs. pressure; its cylinders, having been constructed for special investigation, have an unusually large clearance, and at the time of the tests the valve setting gave excessive lead at very short cut-off. It is significant that these defects were sufficient in their effect to more than neutralize the gain which might otherwise have resulted from the use of higher pressures. It is, in fact, so easy to fail in securing the anticipated gain from increase of pressure, through some minor defect of design or of adjustment, as to make it probable that the most economical pressure for simple engines, in their present stage of development, is within the limits of present practice.

6. High-Steam Pressures for Compound Locomotives.—The maximum pressure for compounds is higher than for simple. Existing data are insufficient to serve as a basis for any prediction as to the effect of successive increments of pressure upon the efficiency of compounds of existing types.

7. High Pressure and Engine Dimensions.—As the steam pressure is increased the size of the cylinders may be reduced. On many roads, the width of engines over cylinders is already very close to the clearance width along the right of way. On such roads a demand for engines of greater power cannot be met by increasing the diameter of cylinders, hence, resort must be had either to a longer stroke of piston or to higher steam pressure.

8. Boiler Pressure vs. Boiler Capacity.—The question of boiler pressure is so closely associated with that of boiler capacity that a brief reference to the latter subject seems desirable.

The proposition to improve the economy of a simple locomotive by increasing pressure beyond present limits is of doubtful value. When viewed as one of several expedients which are open for adoption, it is manifestly not of first importance. For example, within limits now common, an increase in boiler capacity offers a way to increased efficiency which is both sure and significant. If, for example, it is desirable to increase the efficiency of a locomotive now carrying 140 lbs. of steam, by giving it a new boiler of the same dimensions with the old, but designed for a pressure of 200 lbs., the effect produced will be entirely due to increase of pressure. The economy resulting cannot be large, and may, as in the case of experiments already cited, amount to nothing. The new boiler may weigh, approximately, 5,000 lbs. more than the old. Now, it can be shown that if, instead of adding to the weight of the locomotive by making a stronger boiler, the same increase of weight had been applied to making a larger boiler, the resulting economy would not fail to be material.

William F. M. Goss, William Forsyth, Tracy Lyon, Committee.

*Condensed from the report of a Committee of the American Railway Master Mechanics' Association. Presented at the annual meeting at Saratoga, June, 1898.

APPENDICES.

I. Fundamental Facts.

TABLE I.—Some of the More Important Facts Relating to the Use of Steam at Different Pressures.

Gage pressure, lbs. I.	Increase in temperature for each 25 lbs. increase in pressure. II.	Increase in thermal units in 1 lb. of steam for each 25 lbs. increase in pressure. III.	Lbs. of steam per I. HP. per hr. required by perfect engine. Back pressure, 1.3 lbs. IV.	Decrease* required by perfect engine per 25 lbs. increase in steam pressure expressed as a per cent. V.
25	....	....	39.40	....
50	30.9	9.33	26.25	33.4
75	22.3	6.90	21.57	19.1
100	17.8	5.43	19.53	11.8
125	15.1	4.53	17.54	10.4
150	13.0	4.07	16.45	7.30
175	11.6	3.50	15.62	5.97
200	10.5	3.13	15.00	4.85
225	9.5	2.97	14.51	4.22
250	8.8	2.63	14.17	3.37
275	8.1	2.50	13.74	3.27
300	7.6	2.30	13.39	2.93

*Decrease in thermal units per I. HP. per hour.

It will be seen that when the pressure is low, a small change in pressure produces a marked change in the temperature, but when the pressure is higher, changes in pressure have less effect upon the temperature. For example, changing the pressure from 25 to 50 lbs. produces an increase of temperature of 31°, while changing the pressure from 275 to 300 lbs. produces an increase of temperature of only 7.6°. A pressure of steam as high as 300 lbs. involves temperatures which are only a little higher (34°) than those which are already dealt with in locomotive service as a result of pressures of 200 lbs.

The amount of heat needed to produce 25-lb. increments of pressure is shown by Column III. It will be seen that practically it costs no more to make steam at 150 lbs. pressure than to make it at 100 lbs.

No actual engine can ever give a higher performance than that of the perfect engine, but there is no theoretical reason why the performance of the actual engine should not approach and even equal that of the perfect engine. This fact makes the performance of the perfect engine a convenient basis upon which to measure the performance of actual engines. Again, it is often assumed that the effect of a change in steam pressure on the performance of any actual engine will be proportional to the similar effect produced in the performance of the perfect engine by the same change in pressure; so that, if the performance of an actual engine under one pressure is known, its probable performance under any other pressure may be predicted. Such a process is subject to limitations, and is one which can never be depended on to give results with absolute accuracy, but the relation between the actual and perfect engines is sufficiently close to warrant attention in this connection.

Column IV. shows the weight of steam required by a perfect engine when the pressure of exhaust is 1.3 lbs. above the pressure of the atmosphere, and the initial pressure that shown in Column I. Values in Column IV. may be compared with similar values derived from actual engines, but since each pound of steam contains an amount of heat varying with its pressure, they do not fairly represent the relative efficiency of the ideal engine under different pressures. A perfectly logical basis from which to judge the effect of different pressures is expressed in terms of thermal units by Column V., which shows the decrease in the consumption of heat for each 25-lb. increment of pressure.

Two important facts are to be noted in this connection. One is that every increase of pressure results in a definite reduction in the amount of heat consumed per unit of power. It is this fact which is fundamental in any argument favoring increase of pressure. The second is that the rate of change diminishes as the scale of pressure is advanced. Thus, increasing the pressure from 25 lbs. to 50 lbs. reduces the heat consumption of the ideal engine 27%, while an equal increment of pressure from 275 lbs. to 300 lbs. affects the performance of the ideal engine 2.9%. It is evident from this statement of facts concerning the performance of the perfect engine, that chances for improving engine economy through increase of pressure have been greater in the past than they are likely to be in the future. Assuming the present limit to be 200 lbs., the possibility of improving efficiency through increase of pressure alone are not so great as when the limit was 100 lbs.

II. Increase of Pressure and Cost of Locomotive Repairs.

One of the prime difficulties in arriving at any very definite conclusions upon this subject lies in the fact that the greater number of the locomotive boilers now carrying the higher steam pressures have been in service but a comparatively short time. It is the opinion of some of the best authorities that no conclusive evidence bearing upon the maintenance of locomotives carrying higher boiler pressure can now be presented. It should be noted in this connection that by "high pressure" is meant pressure approaching 200 lbs., and by "low pressure" pressures between 140 and 160 lbs.

While much trouble has been had from some of the earlier boilers carrying 200 lbs. steam pressure, in that their construction was to a certain extent experimental, there seems to be no reason why boilers cannot be built to successfully carry such a pressure. A materially increased

weight must be looked for, a thickening of the plates and a more substantial staying and riveting; but this being done, it would seem to be established by close observation that the repairs of a boiler, properly designed for the service, are directly as the horse-power of work performed, irrespective of the pressure carried.

There seems to be no question but that higher steam pressures mean increased wear of the valves and seats, and possibly of the link motion, due to the drag of valves even as well-balanced as the ordinary slide valve may be. This is, of course, directly due to the pressure, in combination perhaps with the difficulty of obtaining sufficient lubrication with the present oiling devices, especially at high speed and short stroke. Those who have used piston valves appear to consider that they meet the requirements of high pressures much more nearly than any other form. The cylinders and piston packing rings are also probably affected by the severer service (see Proceedings, A. R. M. M. Association, 1897, p. 197) as well as the boiler mounting. Rod packing of soft metal may be melted by the higher temperature of the steam with which it comes in contact and harder mixtures required.

One railroad reports the performance of ten engines carrying 200 lbs. pressure, in service from eight months to one year, as compared with the same number of engines carrying 150 lbs. pressure, in service for from ten to fifteen months, the figures given being for four months only.

Cost of running repairs per engine-mile:

High pressure engines	1 32-100 cts.
Average monthly mileage	5,139
Low pressure engines	1 18-100 cts.
Average monthly mileage	3,529

An increase in the running repairs of the high-pressure engines as compared with the low pressure of 12%. Even here, however, the engines carrying the high pressure are much the heavier, and upon a ton-mile basis, instead of a train-mile, the balance is the other way.

It is evident that the available data are too meager to admit of any positive conclusions, but it seems the more probable that the use of high steam pressures need not be attended by any considerable increase in the cost of repairs.

III. Tests upon Locomotives at Different Pressures.

Tests under different steam pressures in the laboratory of Purdue University have involved two locomotives, which with the results obtained from them are briefly described as follows: Schenectady No. 1 is an 8-wheeled engine, weighing 85,000 lbs. and having 17 × 24-in. cylinders. Unpublished data embrace three tests of this locomotive, for which all conditions, excepting that of pressure, were the same. All three tests were run at a speed of, approximately, 35 miles an hour, at a cut-off of about one-third stroke, and with a wide-open throttle. These conditions of speed and cut-off were those which had previously been determined as giving the maximum efficiency. A summary of the data for these tests appears in Table II.

TABLE II.—Showing the Performance of Locomotive Schenectady No. 1 Under Different Steam Pressures.

Consecutive number	1.	2.	3.
Revolutions per minute	188.4	190.0	189.5
Miles per hour	35.0	35.3	35.2
Cut-off, per cent. of stroke	32	32	32
Initial pressure from cards	91.5	115.6	137.3
Increase of initial pressure	..	24.1	21.7
Percentage inc. of initial pressure	..	26	19
Indicated HP.	300	435	522
Increase of power	..	135	87
Percentage increase of power	..	45	20
Lbs. steam per HP. per hour	28.8	26.3	24.9
Decrease in steam consumption	..	2.5	1.4
Percentage dec. steam consumption	..	9	5
Throttle position	Wide open.		
Reverse lever, notch forward of cen.	Second.		

It appears from the table that changing the pressure from 91.5 lbs. to 115.6 lbs., an increase of 24%, increases the power 45%, and diminishes the weight of steam required per horse-power per hour 9%. Again, changing the pressure from 115.6 lbs. to 137.3 lbs., an increase of 22%, increases the power 20% and reduces steam consumption 5%. The steam consumption per horse-power per hour plotted in connection with a curve representing the performance of a perfect engine, appears in Fig. 1. The actual engine is represented by the curve a b, and the perfect engine by the larger curve. This diagram emphasizes two important facts; first, that there is a reduction in the steam consumption of the actual engine, when the pressure is increased; and second, that the rate of change is very nearly proportional to the calculated rate of change for the perfect engine.

This latter relationship is important, since it is often assumed to be a general one, so that if the steam consumption for an engine at any pressure is known, its consumption for other pressures may be definitely calculated. The location of the curve a b, shows that the actual engine consumed about 50% more steam than would have been required by a perfect engine. This percentage is, approximately, constant within the limits of the experiments, and goes far to sustain the generally accepted theory already referred to.

Assuming that the relation of the steam consumption of an actual engine will bear a fixed relation to that of a perfect engine, we may extend the curve of performance. Such an assumption implies that had it been practicable to run higher pressures on Schenectady No. 7 without making any change in the proportions or adjustment of the engine, the steam consumption for the different pressures would have followed the line a c. That is, with a boiler pressure of 150 lbs. the consumption would have been slightly in excess of 24 lbs. per horse-power, while for 300 lbs. the consumption would have fallen below 20 lbs.

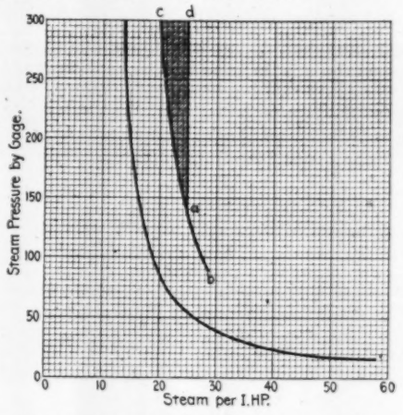


Fig. 1.—Relation of Steam Consumption to Steam Pressure.

The steam consumption of an actual locomotive is shown by the line a b, which is to be compared with the longer curve showing the consumption of steam by a perfect engine. Assuming that at a pressure of 138 pounds an actual engine requires 24.8 lbs. of steam per horse-power per hour, the amount which a similar engine will require when supplied with steam at higher pressures will, if plotted on this diagram, fall within the shaded area a d c.

It is, however, to be noted that while theoretical considerations go far to justify dependence upon the curve a c, as representing the probable performance of the locomotive in question under different pressures, it is after all an assumed curve. The curve a b expresses a fact; the curve a c represents for a greater range of pressures a probable relationship.

Schenectady No. 2.—It is evident that the maximum pressure which could be carried on Schenectady No. 1 was too low to admit of experiments under different pressures which could be depended upon to guide future practice. As a result of this condition and of a desire to further investigate the question of high pressures, as well as to give facilities for research along kindred lines, the Purdue authorities have recently provided a new locomotive, known as Schenectady No. 2.

This locomotive has a boiler of approximately the same dimensions with that of No. 1, but one which is capable of withstanding a working pressure of 250 lbs. The boiler is 52 ins. in diameter, has 1,300 sq. ft. of heating surface, and 17 sq. ft. of grate surface. The cylinders at present in service are cast 20 ins. in diameter by 24 ins. stroke, and have valves and ports suited to these dimensions, but to adapt them to the work under discussion the cylinders were bushed to 16 ins. diameter.

Tests were planned in six different series for which pressures of 90, 120, 150, 180, 210 and 240 lbs. were chosen. Each series was to consist of three tests for which the reverse lever was to be respectively in the third, sixth and tenth notches from the center forward, giving cut-offs of, approximately, 25, 33 and 40%. It will be seen that the plan provided for eighteen tests for which the variables were pressure and cut-off. All other conditions were to be constant. The throttle was to be wide open, and the load for each test such as would hold the engine at a speed of forty miles an hour.

The execution of this outline was intrusted to Prof. Richard A. Smart, from whose report the following facts are summarized:

In attempting to carry out the tests specified, it was found that the power developed by the engines at the chosen cut-offs was considerably greater than had been expected, a result doubtless due to the combination of large ports and bushed cylinders. At the chosen speed of 40 miles an hour, the mean effective pressure was so high, even at the shortest cut-off embraced by the outline, that when the boiler pressure was above 180 lbs. the capacity of the boiler was not sufficient to supply the cylinders. It was necessary, therefore, in order to maintain higher pressures with a wide-open throttle, either to reduce speed or shorten the cut-off. The latter expedient was chosen.

The results, while entirely consistent one with another, and doubtless accurately representing the performance of the engine, are not in all respects such as were looked for. They show, as was expected, that the steam consumption is lowered when the pressure is increased, but they also show that the lowest steam consumption of Schenectady No. 2 was much in excess of that required by Schenectady No. 1. The best performance of No. 2, which was designed for a maximum pressure of 250 lbs., was below the best performance of No. 1, which was designed for maximum pressure of 140 lbs.

This general result is to be traced chiefly to differences in cylinder design. As already noted, the cylinders of the new engine were cast 20 ins. in diameter, with ports proportioned to this dimension, but for the present experiments bushings were inserted, reducing the effective diameter to 16 ins. This arrangement gives an amount of cylinder clearance which is nearly 50% greater than that of the normal locomotive cylinder, and an area of surface bounding the clearance space which is very much larger than that which would bound the clearance space of a normal 16-in. cylinder. It happened, also, that the valve setting, while not bad for any test, could have been made better for those tests which were run under short cut-offs and higher steam pressures.

It is estimated that the defective valve setting may have increased the steam consumption per horse-power per hour under the conditions which prevailed for some of the tests as much as 1 lb., while the excessive clearance, and conditions incident thereto, appear to have affected the steam consumption to the extent of 3 or 4 lbs.

The data justify the conclusion that any increase of pressures is not in itself a guarantee of improved performance. The improvement in performance which is to be expected from small increments of pressure is so small as to be quickly neutralized by any minor defect of design or of mechanism.

Concerning the behavior of engine and boiler under high pressures, it should be said that no difficulty arising from defective lubrication of valves, or from any other cause which might be attributed to the employment of high pressures, was experienced in running tests of 100 miles with no stop, and with the throttle always wide open, under a boiler pressure of 240 lbs. The work at all times proceeded with regularity.

IV. Pressure vs. Capacity.

It may be assumed that the efficiency of a locomotive may be increased either by increasing the pressure on the boiler or by increasing the size or capacity of the boiler. If the pressure is increased, the gain is to be found in the improved performance of the engines; if the pressures remain unchanged and the boiler is made larger, its evaporative efficiency, when developing a given power, will be increased. Either an increase in pressure or an increase of capacity involves greater weight, and as the cost of a boiler of any given type will be approximately proportional to its weight, the whole question may be resolved into the following statement, namely: Shall any added weight which may be given the boiler of a locomotive be devoted to increasing its strength that a higher pressure may be carried, or to increasing its capacity that it may render its service while working at a correspondingly lower rate of power?

Efficiency and Capacity.—The evaporative efficiency of a boiler depends on the rate of power to which the boiler is worked. The relation of efficiency and power, as defined by a large number of tests made upon the boiler of Schenectady No. 1, at Purdue, is shown by Fig. 2. It will be seen that when the power is such as will require 5 lbs. of water to be evaporated per sq. ft. of heating surface per hour, 8½ lbs. are evaporated for each pound of coal burned; but when 15 pounds of water must be evaporated per sq. ft. of heating surface per hour, only 5½ lbs. are evaporated per pound of coal. Strictly speaking, the relationships disclosed by Fig. 2 apply only to the boiler from which they

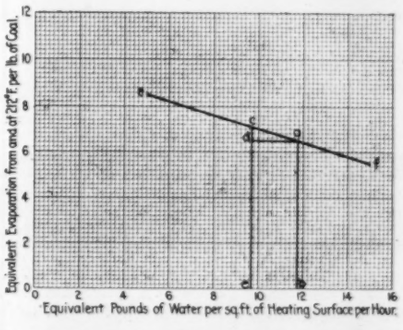


Fig. 2.—Relation of Boiler Economy to Rate of Evaporation.

were derived, but as all locomotive boilers of usual form may be expected to give a curve of the same general character, that which is presented may be employed as the basis of the following general illustration. Thus, suppose that the demand for steam upon what may be called a "normal" boiler is such as to require the boiler to work at the point a on the curve of efficiency. If, now, the same demand for steam is supplied by a boiler whose heating surface is greater than that of the normal boiler, the larger boiler will work at some point, c, higher on the curve of efficiency; the increase in efficiency will be represented by the ratio of c d to a b. An inspection of the figure will show that the value of the ratio depends upon the length of the line d a and upon the location along the efficiency curve of the initial point a. That is the increase in efficiency depends, first, on the amount of increase of heating surface, and, second, on the rate of evaporation of the assumed normal boiler.

The saving which results from increasing the capacity of a boiler is most marked at high power. Thus, an increase of 20% in the size of a boiler increases the evapora-

tive efficiency only 2.9% under a development of power which would be supplied by the normal boiler, by an evaporation of 5 lbs. of water per foot of heating surface per hour, but increases to 13.6% when the power is increased threefold.

A UNION STREET RAILWAY STATION IN WASHINGTON, D. C.

(With two-page plate.)

In our issue of Feb. 24 we described the plan adopted by the Capital Traction Co., of Washington, D. C., in converting their road from a cable to a conduit electric system. The same company about a year previous completed an extension of its tracks a few blocks on M St., to the north end of the Aqueduct Bridge, which connects with Virginia, and affords practically the only convenient means of access to Fort Meyer, the government cavalry station, and a large section of contiguous country.

Congress, in permitting this extension and the construction of a building suitable for car storage, required the company to make the building of such a character as to admit of its use by other street railways and suburban lines for car storage, and for the convenience of waiting passengers. About the only location available was a steep hill directly north of M St., Fig. 1, where there is a rise of about 60 ft. in the 250 ft. between M St. and Prospect Ave. It was decided to excavate this hill to the level of M St., and erect the building in the space thus made. It was thought from preliminary borings that under the top soil an unstratified blue gneiss lying in long broken masses would be met with, and upon this assumption plans were first made for face walls of brick 4 ft. thick about the three sides of the excavation. As it was desirable to obtain as much room as possible for the storage of cars, and as the plan would not interfere with the street, the Building Department permitted the construction of the north wall under the sidewalk of Prospect St., Fig. 7, as an "area wall," thus enabling the curtain wall or side of the building to be on the building line. For various reasons the city Building Department opposed the plan of a simple face wall so persistently that to meet its requirements the plans were changed to a retaining wall of sufficient strength to sustain loose material. The maximum difference in elevation between the ground level at the top and bottom was about 56 ft., and the revised plans called for a wall 11 ft. thick at the base, stepping off to 3 ft. 6 ins. at the top. The local building inspector would not accept this plan, and insisted upon the walls being 22 ft. thick at the base, somewhat, as may be imagined, to the surprise and consternation of the company's engineer. After some discussion a "compromise" concrete wall was agreed upon, to be 13 ft. thick with 4 × 4-ft. brick pilasters placed at intervals of from 13 to 20 ft., to be built up as the construction of the work progressed. As an additional precaution box girders were used on the second and third floors abutting against the east and west walls, thus bracing them against each other. These girders were figured both as columns and as girders to resist, besides the strains from floor loads, a thrust of 200 lbs. per sq. ft. of wall surface. Girders and I-beams were built into the pilasters parallel to the walls, Fig. 2, upon which the curtain walls were built to form the exterior of the building. In this way "areas" were left between the curtain and retaining walls which serve the double function of ventilating shafts and light wells. The inclined wall, Fig. 2, forming the foot of 36th St., and that portion along the stairway, Fig. 2, shown in detail in Fig. 3, were built of squared rubble (Blue Gneiss) for appearance sake. With the exception of this street wall the walls were all built in trenches; that is, the proper location of the walls being staked out three trenches, intersecting at right angles, were started and carried down to about 3 ft. below the level of the finished first floor. In Fig. 3 the shoring of the surface earth and the cableways over the trenches, which were used to remove the rock and dump it into wagons, are clearly shown. The rock in the trenches was solid and almost without seams and had to be loosened by blasting, and this was true of the entire mass over the whole site except for a few feet of surface soil and rotten rock on top. Against the interior face of the trench walls wooden forms were placed and concrete was filled in, the pilasters, already mentioned, being built at the same time of hard cherry brick laid in 2 to 1 Portland cement mortar. The actual rock face formed the other side, and all irregularities and cavities made during excavation were filled in solid with concrete. As the filling-in progressed numerous "weepers" of 2-in. wrought-iron pipe were placed in the wall. After the removal of the framing the east wall, which was to be exposed to view from the interior of the building, was given a coat of cement plaster. After the completion of the walls the excavation of the interior portion was begun. In this work some 90,000 cu. yds. of material, nearly all rock, was drilled, blasted and hauled in wagons across the river and dumped upon the south approach of the Aqueduct Bridge. The general appearance of these retaining walls after the removal of the center portion, and just previous to starting the building, is well shown in Fig. 2. The excavation measured from outside of west wall to outside of east wall about 194 ft., and was about 247 ft. the other way.

The building proper is three stories high, 242 ft. deep, and has a front of 180 ft. It is built of brown mottled brick, with white stone trimming and steep-pitched red tile roofs. The general appearance of the front is well shown by Fig. 8. The tower, which contains passenger elevators, is 140 ft. high, and is capped with a steep red tile roof. The flat roof of the portion used for car storage, seen best in Fig. 5, is on the level of Prospect St. in the rear, and was designed with an idea of its possible future use as a summer roof garden. In the center is a covered passageway leading from the Metropolitan railway on Prospect St. to the elevators in the tower. That portion of the building facing on M St. is devoted to terminal offices of the various railways, and waiting and toilet rooms for passengers making transfers. These rooms are handsomely finished in red oak wainscoting, delicately-tinted walls, panelled ceilings of stucco with rich corners and decorations, granata floors, ornate black iron grilles and stair railings. The entire lower floor is occupied by the terminal arrangements of the Capital Traction Co.

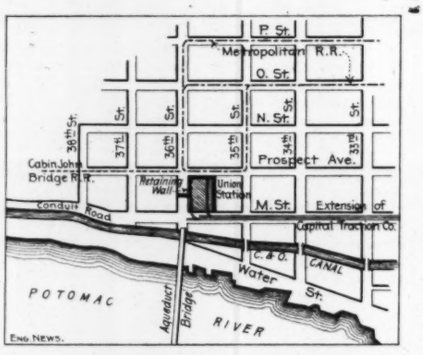


Fig. 1.—Map Showing Location of the Union Street Railway Station in Washington, D. C.

Directly in the rear of the waiting rooms, on all three floors, are long corridors, 25 ft. wide, with space for two car tracks and necessary switches for the use of foreign cars which may enter the building. These will be brought in on steel trestles, those from the lower level onto the second floor, and those from the higher level onto the third floor, the lay of the land in the vicinity being such as to make this possible. As most of the suburban lines during the hours of slack traffic run their cars at comparatively long intervals, it is believed that the Union Station will prove a great convenience. In the rear of the waiting rooms and track space already mentioned are located the car storage portions. This space is the full width of the building and 177 ft. long, and except for a central light shaft, 19 ft. 7 ins. wide, the space from ground to roof is occupied by the storage tracks, 12 in number, on each floor. Transfer tables across the entire width at either end and car elevators are also provided. The floors in the car storage portion are somewhat [illegible]. In this work 7-in. 85-lb. grooved girder [illegible] rails are used, spaced 4 ft. 10 ins. c. to c., resting upon I-beams. Between the rails the Ransome system of concrete fireproof flooring was [illegible]. Fig. 7 represents a section through the rail, showing the covering of the lower flange and [illegible] flat slab forming the floor between, also the [illegible] of fireproofing main I-beams with metal [illegible] of twisted wire. This floor weighs 28 lbs. per sq. [illegible] and was calculated to stand a safe load of [illegible] lbs. per sq. ft. Previous to its adoption a test [illegible] was made to determine its strength. Fig. 8 was taken directly after the first failure, and before the total collapse; it represents the entire load [illegible] 12,160 lbs. resting upon a block which has an area of 1 sq. ft. The final failure of the test floor resulted from excessive deflection, causing the concrete below the twisted wires to crack and separate from them by stripping for about half their length; the wires, however, gave no indication of undue straining.

The entire work of design and construction was under the direction of Mr. D. S. Carll, Chief Engineer and Superintendent of the Capital Traction Co., and Mr. Waddy B. Wood, architect. We are indebted to Mr. John Meigs, of Washington, D. C., who was connected with the work and made all the calculations for the steel work of the building, for the material from which this article was prepared.

AN OIL FILTER FOR BOILER FEED WATER AT PEORIA, ILL.*

By Dabney H. Maury, Jr., M. Am. Soc. M. E.†

The main steam pumping plant of the Peoria Water Co. consists of three Worthington compound condensing duplex vertical high duty pumping engines of 7,200,000 gallons daily capacity each, against a pressure of about 125 lbs.; with six Heine water tube boilers of 200 HP. each, or 1,200 HP. in all; and the necessary boiler feeders, air pumps, jacket pumps, dry well pumps, air compressors, electric light engine and dynamo.

The pumping engines are rated at 100,000,000 ft.-lbs. per 1,000 lbs. of steam. Usually but one pumping engine, with the necessary auxiliaries, and two boilers, of a total of 400 HP. are in use at a time, the time of actual pumping averaging 17 hours per day.

In May, 1896, the writer made a test of this entire steam pumping plant under ordinary working conditions, with a view to determining the lines on which improvements could be made in its operation. A description of this test was presented as a paper before the Illinois Society of Engineers and Surveyors at its Springfield meeting in 1897. I quote the following from that paper:

> In the light of the information furnished by the tests, the following changes were made in the feed-water return system. It was considered of first importance to diminish the deposition of scale and oil in the boilers. To accomplish this, the writer decided to use as much condensed steam, and as little fresh feed-water, as possible; to separate the oil from the condensed steam (which has no scale-forming ingredients); and to remove the carbonates and sulphates from the fresh feed water (which has no oil), treating the two separately before allowing them to mix in the boilers. . . . . A trial showed that the emulsion of the oil and the water could not be separated by gravity. Arrangements are now made to remove as much of the oil as possible by filtration. A portion of the oil in the exhaust steam from the auxiliaries is removed by the Austin separator set on the exhaust pipe line from these pumps to hot well.
>
> The fresh feed water . . . . is forced by the pressure in the mains, through a 50-HP. Hoppes live-steam purifier, purchased for the purpose, which removes a considerable portion of the salts of lime and magnesia. The advantage of treating the fresh and condensed feed water separately will be apparent when it is remembered that if all the feed water had to be treated to remove the salts, a purifier of 800-HP. would have been required to do the work now done, and with a margin to spare, by the one of 50-HP. capacity.
>
> . . . . A small Crown meter measures the fresh feed water before it goes to the purifier. This little meter plays an important part in the economical operation of the plant: for an excess in its registration during any man's watch means either that pipes or valves are leaking or that the man has been negligent; and each man is encouraged to reduce the meter readings to a minimum. Leaks that formerly went undetected for long periods, owing to the very large number of pipes and valves in the system, are now promptly discovered.

As will be seen from what I have just quoted, which was written in the latter part of 1896, no serious difficulty was anticipated in filtering the oil from the condensed steam. But before satisfactory results were reached we learned that the problem was not so simple after all.

The condensers are of the surface type, and the air pump which returns the condensed steam from them to the hot well was already pumping against almost as great a head as it could manage, so that it was not feasible to add enough to its load to enable it to force the water through

*A paper read before the Buffalo Convention of the American Water-Works Association, June 14 to 16, 1898.

†Superintendent of Peoria Water Co.

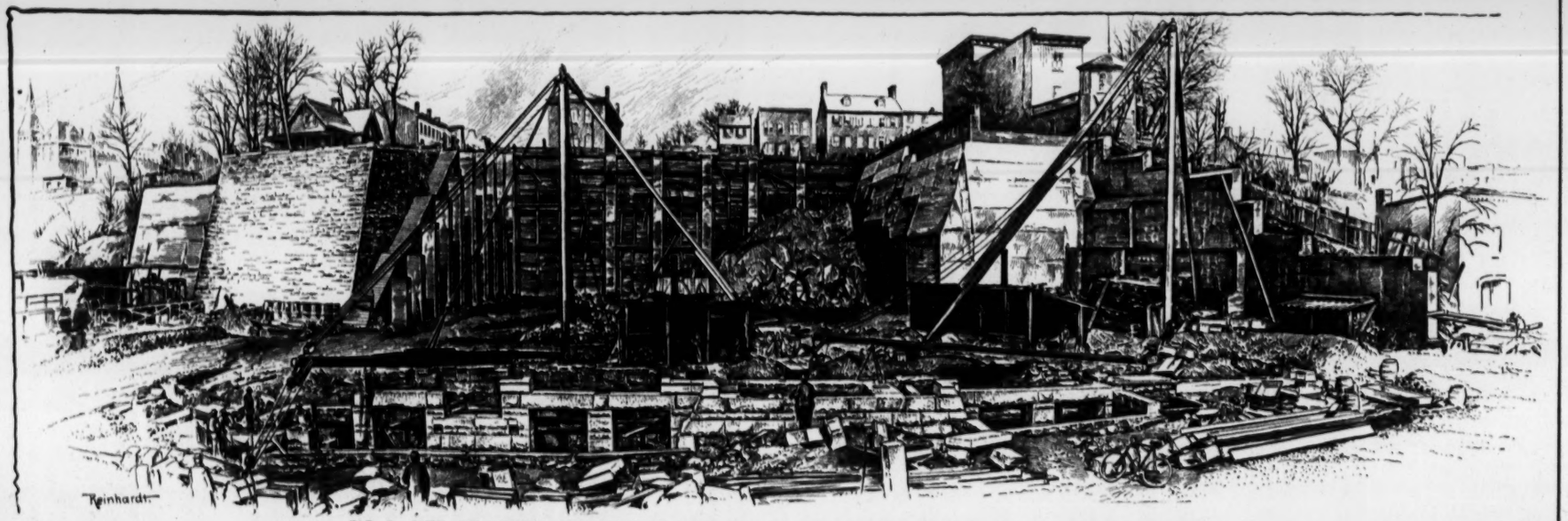


FIG. 2. SITE OF UNION STATION SHOWING SIZE OF EXCAVATION, RETAINING WALLS AND PILASTERS.

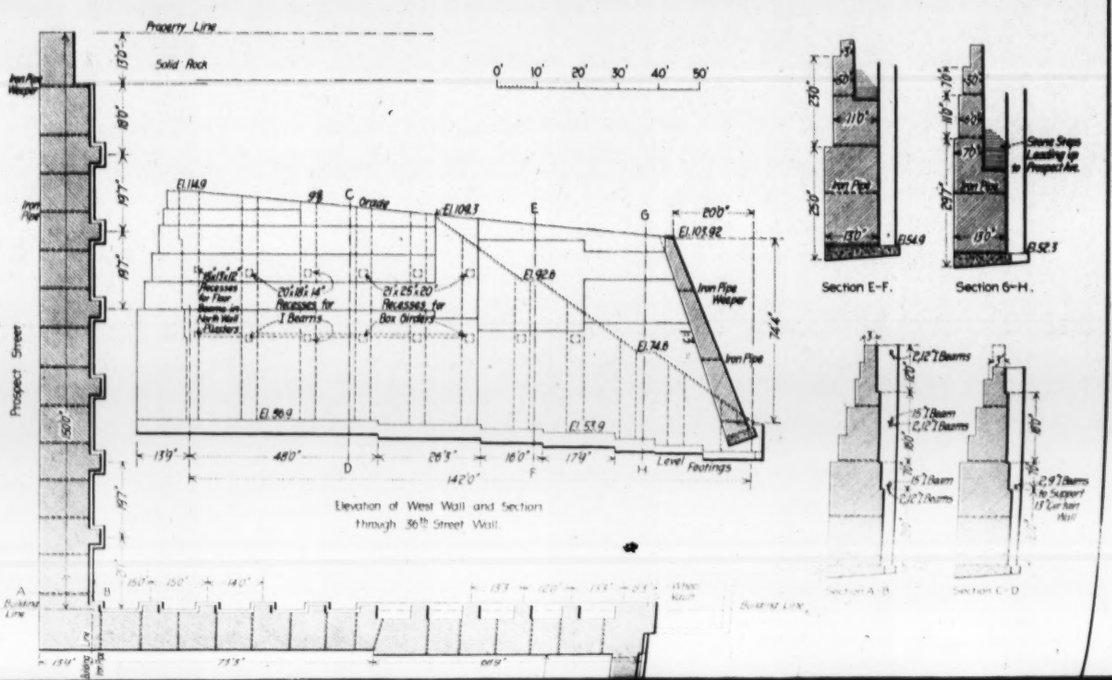


FIG. 4. PLAN AND SECTIONS OF WEST AND NORTH WALL AND THE WALL AT END

FIG. 3. A PORTION OF ONE OF THE TRENCHES SHOWING SHORING AND CABLEWAYS.

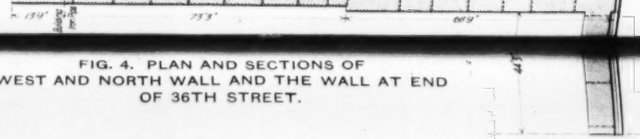


FIG. 4. PLAN AND SECTIONS OF WEST AND NORTH WALL AND THE WALL AT END OF 36TH STREET.

FIG. 8. SECTION OF RANSOME CONCRETE FLOOR UNDERGOING TEST.

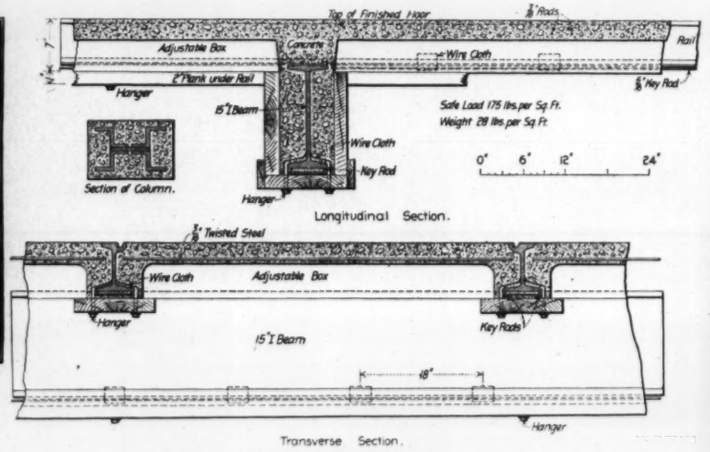


FIG. 7. DETAILS OF RANSOME CONCRETE FLOOR USED IN CAR STORAGE PORTION.

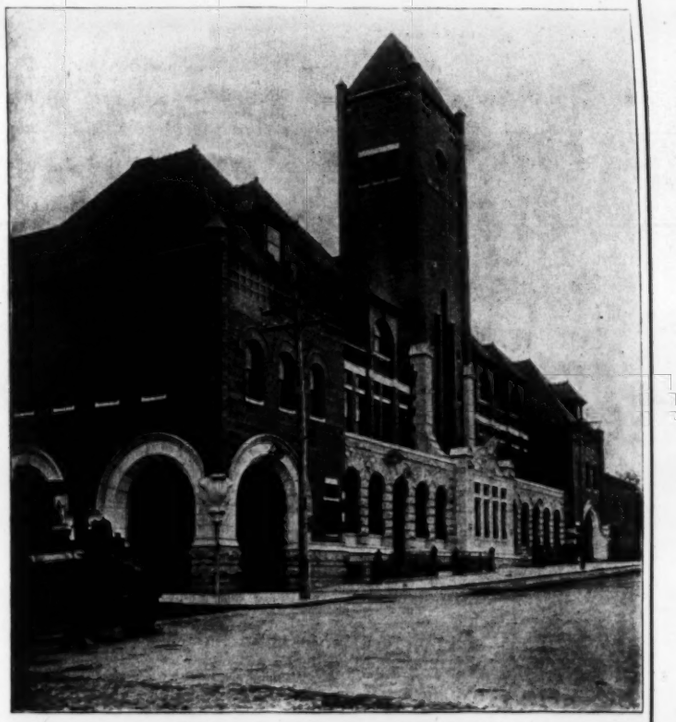


FIG. 6. FRONT VIEW OF STATION.

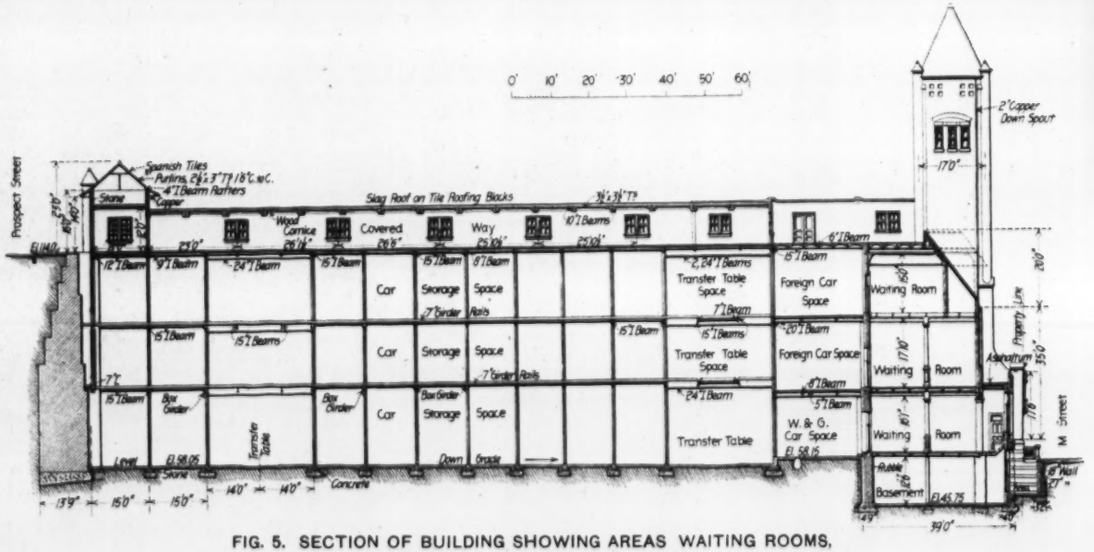


FIG. 5. SECTION OF BUILDING SHOWING AREAS WAITING ROOMS, CAR SPACE AND STORAGE SPACE.

A UNION STREET RAILWAY STATION, WASHINGTON, D. C.

a pressure filter. It was, therefore, decided to employ the gravity type.*

Having decided to employ gravity filters, it was of course deemed desirable to avoid the use of coagulants.

As the condensed steam was absolutely pure, except for oil, and as a large part of the scale forming impurities in the very small proportion of fresh water used would be removed by the live steam purifier, some method of removing the oil from the condensed steam was all that was needed to make an almost perfect feed water, with all the blessings attendant thereon.

The first filter tried was a 30-in. galvanized iron tank with perforated bottom, which was conveniently set over

Fig. 1.—View of Oil Filter for Boiler Feed Water, Peoria, Ill.

Dabney H. Maury, Jr., M. Am. Soc. M. E., Superintendent Peoria Water Co.

a reservoir connecting with the hot well. This tank contained about 1 ft. in depth of sponges, held between the meshes of a pair of strong wire gratings. These gratings could be squeezed together or loosened, by a bolt and nut, and the filtration could be made fast or slow as desired. The sponges did not seem to catch much oil, so cotton waste was tried, instead, with no better results. After this, straw, hay, excelsior and coarse cloth were tried in turn, and while the rate of filtration required to get all the condensed steam through the small filter area was unquestionably too rapid, the results gave no encouragement, and the oil caught would hardly have sufficed to grease the proverbial gimlet.

All this time we were taking well-meant advice from our friends, and the prescriptions were as numerous as those described by Mark Twain in his famous chapter on Membranous Croup, there being one point of resemblance in them all—their failure to afford relief. At last, however, a filter man told us of a certain steam plant in which the boiler feed water, consisting principally of condensed steam, was simply filtered through coke and sand without coagulants and with good results. An investigation was made of this plant, and it was found that while the constructing engineers had indeed designed the filters to be operated without coagulants, the men employed to operate the plant sometimes used alum and sometimes did not, and could give but little information as to the results in either case. The general impression gathered by us, however, was that the rate of filtration was too rapid, and the effluent was not very different in appearance from the raw water. Nevertheless our next attempt was with coke and sand as filtering media, and for the first time there seemed to be some prospect of success. A couple of old cocoanut-oil tierces were fitted with the necessary inlet pipes, strainers, outlets, valves, etc., and into one was placed about 4 ft. in depth of screened sand, while the other was charged with 1 ft. of powdered coke on top of 3 ft. of sand. The effluent from these crude filters seemed slightly better than the raw water, but the improvement was hardly noticeable. The results seemed to show, however, that a much slower rate of filtration might be successful, so a sand filter consisting of three compartments, each of twice the area of one of these tierces, was designed and ordered built.

About this time the writer, still in search of light on the subject of oil filters, put into the Question Box at the Denver meeting of this Society a request for information as to the best method of removing oil from condensed steam for boiler feeding. My query was not answered, except that after the meeting I was told by an authority on filters that the only way to get rid of the oil was to use a coagulant, putting into the already softened water enough lime to precipitate the alum.

After my return from Denver the new filters were finished, and were put in operation Aug. 29, 1897. They have been in service ever since. The accompanying photographs and drawings, Figs. 1 and 2, show their construction. No especial claim is made for originality, as the general arrangement of valves and piping is similar in many respects to that commonly seen in mechanical filters, but it seemed to the writer that a complete record of the results of an experiment which was so successful in our case might be of interest to other steam users who are troubled with bad feed water.

As seen by the photograph and drawings, a steel tank is divided into three equal compartments, known respectively as Filters Nos. 1, 2 and 3. All these filters are generally used at once. When one requires cleaning it can be shut out and cleaned without interrupting the use of the other two. The area of each filter is about 12.25 sq. ft. Filter No. 1 contains crushed quartz, while filters Nos. 2 and 3 contain screened sand. The depth of quartz and sand in each filter is about 3½ ft. The raw water is raised by the air pumps from the condensers through the 3-in. pipe at the right of the tank into the 12-in. cast-iron distributing pipe over the filters. This water is freed from air by the two risers shown. Three 1-in. valves, A1, A2 and A3, admit the raw water through a gridiron of perforated pipes to the top of the sand. In the bottom of each filter are 30 strainers connected to the 2-in. outlet pipe. These strainers are simply brass cups threaded at the bottom with ½-in. male pipe thread, and covered on top with fine brass wire gauze stretched and soldered, for strength, over heavier wires, which in turn are soldered to the cups. The 2-in. valves, E1, E2 and E3, regulate the outflow from the filter to the hot well. The 1½-in. valves, D1, D2 and D3, control the clean water from the city mains used to wash the filters, while O1, O2 and O3 are ¾-in. valves on the steam line used when necessary for heating the wash water. Plugs in the 3-in. line at B1, B2 and B3 are employed instead of the more costly and cumbersome valves for opening or closing the overflows or wastes from the filters while washing. The overflow or wash water runs out through the pipes on the left of the tank to the

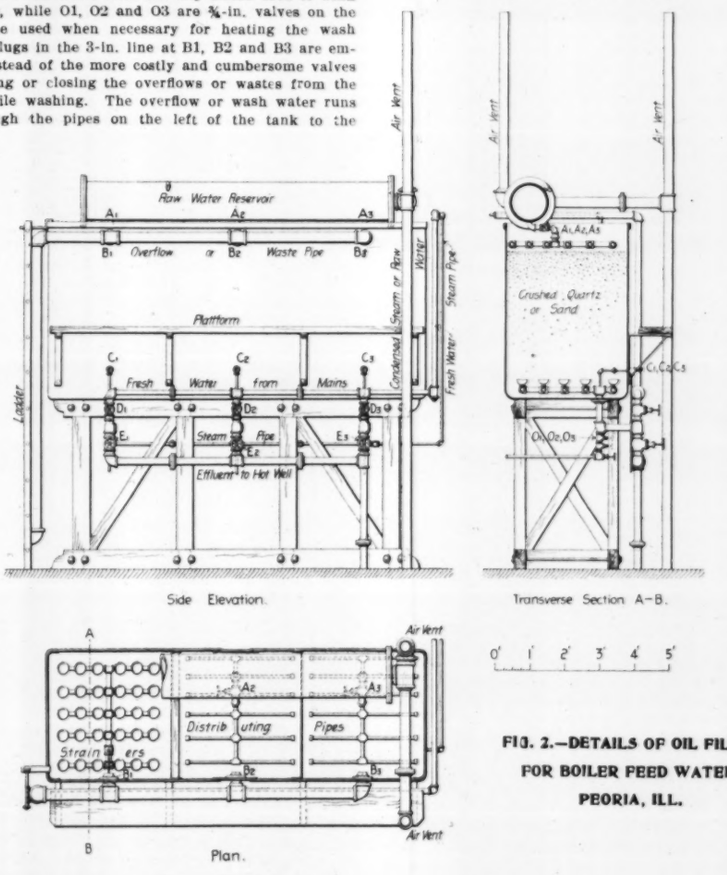


FIG. 2.—DETAILS OF OIL FILTER FOR BOILER FEED WATER, PEORIA, ILL.

sewer. While washing, the sand is from time to time stirred with a hoe or paddle. For taking samples of the effluent, while the filters are running, the three ¼-in. angle valves, C1, C2 and C3, are provided. These valves control ¼-in. pipe lines tapped into the outlet pipes inside the filters and terminating at their outer ends just below and behind the effluent pipe line. To take a sample from Filter No. 1, for instance, the 2-in. outlet valve, E1, is closed, and the ¼-in. angle valve, C1, is opened, and the water flowing from the quarter-inch pipe is caught in a bottle or other suitable vessel. The tank is supported on a framework of oak resting on concrete foundation. A steel ladder gives easy access to the board platform from which the upper parts of the tank can be readily reached.

Before this filter was put into service, and during the period in which we were trying to use as much condensed steam as possible instead of fresh water, the oil in our boilers was giving constant and very serious trouble. The lowest row of tubes in each boiler buckled up from 4 to 7 ins., and leaked almost without exception. It was necessary to shut down at least once a week and swage up, and frequently to renew the tubes in this row. There was little or no scale in the boiler, but a brown gummy or viscous coating was found, especially near the bottom of the rear water leg and in the lower tubes. Since Aug. 29, 1897, the record is very different. There has never been a shut down to repair a boiler, and no new tubes have leaked. Boilers are kept under steam constantly day and night from two to four months, and when opened show only a soft scale of a maximum thickness a little greater than that of blotting paper.

Below follows a detailed statement of the conditions under which the filters and boilers were operated:

Period covered, Aug. 29, 1897, to May 31, 1898, 276 days.
Actual time pumps and filters were running, 4,635 hrs.
Approximate total evaporation of feed water by boilers, 38,383,000 lbs.
Approximate total fresh water, 3,518,000 lbs.
Approximate total condensed steam, 34,865,000 lbs.
Percentage of fresh water in total feed water, 9.2%.
Percentage of condensed steam in total feed water, 90.8%.

Analysis of Fresh Water, Grains per Gallon.

Nitrate of potassium	0.617
Nitrate of sodium	0.294
Chloride of sodium	2.508
Sulphate of sodium	2.407
Sulphate of magnesium	3.213
Carbonate of magnesium	0.205
Carbonate of calcium	15.917
Oxides of iron and aluminum	0.046
Silicic acid	0.840
Total	26.137

Water is remarkably clear and contains nothing in mechanical suspension. Hardness of fresh water, 20° by Clarke's scale.

Kind of oil used in cylinders, Kellogg's opaque anti-corrosive cylinder oil.

Total cylinder oil fed into main engines, 48 gallons = 192 qts. = 0.7 qt. per day.

All of this oil went into the engine cylinders and passed thence through the condensers to the filters, except such oil as may have been caught by the condensers.

Total cylinder oil fed into auxiliaries, 46 gallons = 184 quarts = 0.67 quarts per day.

An unknown proportion of this oil was removed by the Austen separator on exhaust pipe line from auxiliaries to hot well and did not get into the boilers.

Average temperature of condensed steam entering the filters from the air pumps, 56° F. This low temperature is due to the low temperature of the condensing water (50° F.) and to the large area of condensing surface. The water generally leaves the filters several degrees warmer than it enters.

Number of washings of filters in 276 days: Filter No. 1, 11 washings; No. 2, 9; No. 3, 11.

Average number of days each filter ran without washing, 26.7 days.

*For those who may desire to look into the subjects of oil in feed water and of oil filters, the following references are suggested: Trans. Am. Soc. M. E., Vol. XIII., pp. 248 to 258; Vol. XIV., pp. 118 to 146; Vol. XVII., pp. 295 to 315; and Cassier's Magazine, Oct., 1897. "Marine Feed Water Filtering," by Nisbet Sinclair.

Time consumed in washing as follows: Water is allowed to run slowly from the city mains with a little steam if necessary for about 1½ hours. The sand is stirred at intervals for a few minutes at a time. The washing is done by the regular firemen on duty at the time.

Area of each filter, 12.25 sq. ft.
Combined area of all three filters, 36.75 sq. ft.
Depth of sand or quartz, 3½ ft.
Rate of filtration: In lbs. per hour, 7,426; in gallons per hour, 89.5; in cubic feet per hour, 11.88; in gallons per acre per 24 hours, 2,546,024; in vertical inches per hour, 3.87.

Cost of filter for concrete foundation, oak frame steel tank, screened sand, crushed quartz, and such pipes, valves and fittings as were not in stock	$135.00
Estimated value of material used from stock.....	55.00
Total	$190.00

N. B.—The most of the pipe fitting was done by the regular pumping station crew; all other labor is included in the first item of $135.

Repairs to boilers since filters have been in service, none.
Repairs to filters, none.
Annual saving in boiler compound, $175.
Estimated annual saving in coal, due to absence of oil and scale, 10% of coal bill, $400.

N. B.—There is also a large annual saving in repairs to boilers and in boiler cleaning, but the actual amount of this is difficult to estimate.

Observations of the working of the filter show that at first, after cleaning, the filtration is not as thorough as after the filter has been running a few hours. This is doubtless due partly to the fact that the sand is loosened up by the washing and requires time to settle again and close the voids, and partly to the fact that the film of oil formed over the top of the sand after the filter has been running a short while, materially aids the filtration. It was difficult to tell whether the sand or the quartz was the more efficient filtering medium, but it is believed that the best results under equal rates of filtration were obtained from the quartz. In every instance, however, it was noted that slower filtration increased the efficiency of the filter. Before making this filter the writer made inquiry of several prominent filter men and was informed that no patents would be infringed by its construction, and if this account of our experience should lead to the use of some similar device by any fellow sufferer from the evils of bad boiler feed water, the writer will feel amply rewarded for the time and labor spent in the preparation of this paper.

THE LOSS OF WATER FROM RESERVOIRS BY SEEPAGE AND EVAPORATION.

We are indebted to Prof. L. G. Carpenter, Meteorologist and Irrigation Engineer to the Agricultural Experiment Station at Ft. Collins, Col., for advance pages of Station Bulletin No. 45, having the title given above. For many years Professor Carpenter has been studying a variety of questions relating to irrigation engineering, some of which have a direct bearing upon water supplies for other purposes. The bulletin just received is applicable to all classes of reservoirs, regardless of their use, but there are many local conditions that would affect the evaporation and seepage from reservoirs. Most of these are mentioned in the bulletin, but perhaps a little more stress should be laid on the size of the reservoirs. The principal effect of size as measured by area, perhaps, is on the wave action; this, perhaps, as Professor Carpenter points out, increasing the exposed surface, and thus the evaporation. Depth, the bulletin states, tends to increase seepage, evidently from an increase in head, but this should be partially offset by a diminution in temperature, which, as shown in our issue of May 12, lessens seepage. Area, again, should decrease seepage in so far as the latter is through the sides or embankments of a reservoir.

The bulletin gives a brief summary of the results of other observations on evaporation, but there seems to have been scarcely any studies of seepage from reservoirs except those by Professor Carpenter. The evaporation studies at Ft. Collins have been kept up for over eleven years, by means of a tank on the college ground. These have been supplemented, of late, by observations on floating tanks in a number of ponds and reservoirs within ten miles of Ft. Collins.

The conclusions drawn by Professor Carpenter are as follows:

(1) The losses from reservoirs are from seepage and evaporation.

(2) The seepage losses are dependent on the condition of the reservoir site, therefore different for different sites.

(3) The seepage losses were determined on a series of reservoirs near Fort Collins, in the winters of 1895-6 and 1896-7.

(4) The seepage losses may be great. In the lakes under measurement, the losses in some cases were less than from evaporation alone.

(5) In some cases, lakes may gain from seepage from irrigated lands, and the gain may be more than the combined loss from seepage and evaporation.

(6) In the cases where loss from seepage occurred, the loss was at the rate of about 2 ft. in depth over the area of the lake, per year.

(7) This amount does not necessarily apply to other sites, and other observations are needed before general statements respecting loss from this source can be made.

(8) The seepage decreases after the lake is first filled, from the effect of silting, and from having filled the porous ground underneath and connected with the site.

(9) Even in sand, there is a limit to the amount of seepage, and the time during which the loss is large.

(10) After sand beds connected with the reservoir are saturated, the losses from seepage will decrease.

(10a) The loss increases with the depth, probably nearly as the square.

(11) The losses may be lessened, though not entirely prevented, by silting.

(12) The silting process is more efficient with small reservoirs, because of the better distribution of the silt.

(13) If the loss from seepage is not more than 2 ft. per annum, the sites may be considered as practically water tight. In the case of canals, the losses often average more than that in 24 hours.

Evaporation.

(14) The losses from evaporation, in the case examined, are greater than those from seepage.

(15) The evaporation is not necessarily the same from adjacent bodies of water.

(16) The amount of evaporation increases with the temperature of the water, with the wind, and diminishes with increased moisture in the air.

(17) From the standard evaporation tank at the Experiment Station, the average evaporation for 11 years has been 41 ins.

(18) Evaporation proceeds when the water is frozen, but at a diminished rate, averaging about 1 to 1½ ins. per month.

(19) The evaporation at night is the same as during the day, the difference being less with the increase of the size of the bodies of water.

(20) The loss by evaporation from several lakes exceeded that from the standard tank.

(21) The loss from the lakes was about 60 ins. per year.

(22) The increase is due to higher temperature of the water, and to freer exposure to the wind.

(23) In some of the summer months, the lakes lost twice as much as the standard tank.

(24) The lower temperature of water at high elevations, and the lower dew points, tend to decrease the evaporation.

(25) The diminished barometric pressure tends to increase the evaporation, amounting to 14% at 8,000 ft., and to 18% at 10,000 ft., over the evaporation at 5,000 ft.

(26) Every mile of wind movement in 24 hours increases the evaporation by from 1% to 2% over the evaporation if calm.

(27) The winter period is longer at the high elevations.

(28) For the whole year, the evaporation in all probability is considerably less at the high elevations than at the low ones.

(29) Evaporation is lessened by any influence which diminishes the wind or decreases the temperature of the water.

(30) Protection of lakes by wind breaks is in many cases practicable, and in small lakes sometimes desirable. In the large lakes the benefit is by reducing the wind velocity; in small lakes both from effect on wind and by lessening action of sun.

(31) The deeper the lake the cooler the water as a whole, the cooler the surface, consequently the less evaporation.

(32) Assuming a loss of 5 ft. in depth per annum, an area of 100 acres would require ¾ cu. ft. per sec. for the whole year to make good the losses from evaporation; one of 500 acres would require 3½ cu. ft. per sec., considerably more than would be used to irrigate an equal area.

(33) The net loss to the reservoir would be the sum of the above losses from seepage and from evaporation, diminished by the rainfall, a combined loss which may be considerel as a depth of 6 ft. in one year.

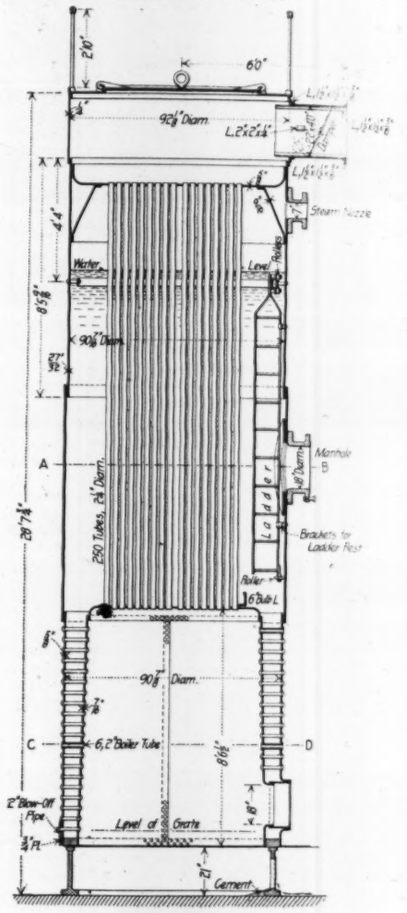
(34) As irrigation reservoirs are usually full for a few months only, the loss is much less than this for the high water area.

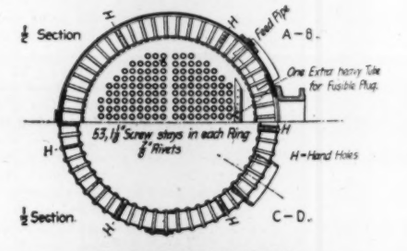
A VERTICAL STEAM BOILER OF NOVEL DESIGN.

We illustrate herewith an internally fired vertical tubular boiler, designed by Dean & Main, engineers, 53 State St., Boston, Mass., and erected in the chocolate factory of the Walter M. Lowney Co., in that city. The boiler is patented by Mr. F. W. Dean, M. Am. Soc. M. E.

A novel feature in the design of this boiler is the unusual height of the firebox, 8 ft. above the grate, and 8½ ft. above the bottom of the boiler. The large space thus provided allows of the almost complete combustion of the gases from semi-bituminous coal before they enter the tubes, and consequently renders the boiler almost smokeless. The water space in the leg is 6 ins. wide at the bottom and 8 ins. at the top.

Another novel feature of the boiler is the provision to permit internal inspection of the shell, crown sheet, and to some extent the tubes. This is accomplished by providing sufficient distance between the shell and the tubes to allow a man to walk around on the edge of the crown sheet and on the upper row of stay bolts. For the portion of the shell above a man's head a permanent iron ladder is provided which rolls around on a circular track. This ladder moves easily, and an inspector can push himself all around the boiler. When not in use the ladder is clamped at top and bottom to the shell, so that the ebullition of the water will not cause it to vibrate.





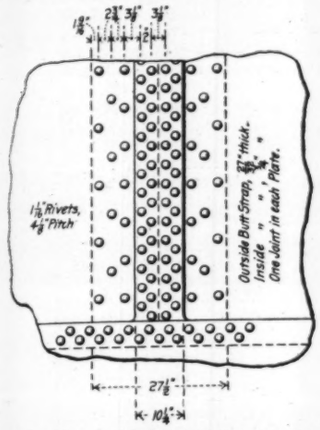
VERTICAL STEAM BOILER.
Patented by F. W. Dean, M. Am. Soc. C. E.
Designed by Dean & Main, Engineers, 53 State St., Boston, Mass.

The upper tube sheet is stayed by a conical plate riveted to the shell and tube plate. This plate is perforated at the top and the space between it and the shell is used as a steam receiver, from which the steam enters the nozzle on the side of the boiler.

The upper smoke head is made square and provided with a hand rail, to give ample room and safety for men cleaning tubes.

The following are the leading dimensions of the boiler:

Steam pressure by gage	200 lbs.
Diameter of grate	78 ins.
Outside diameter of tubes	2¼ "
Length of tubes between plates	15 ft.
Number of tubes	250
Water-heating surfaces (fire sides)	1,653 sq. ft.
Super-heating " " "	565 "
Total	2,218 "
Grate surface	33 "
Ratio of grate to water-heating surface	50.1
Ratio of grate to total heating surface	67.21
Total area of tube openings	5.75 sq. ft.
Ratio of tube opening to grate surface	5.74
Ratio of smoke flue to grate surface	4.50



System of Riveting Longitudinal Joints in Shell of Dean's Vertical Boiler.

It appears that in this design Mr. Dean has overcome two of the chief objections to a vertical tubular internally fired boiler, viz., 1, that there is no room for a man to get inside of it for inspection or cleaning; and, 2, that there is not sufficient room in the fire-box to allow of the complete combustion of the gases. Mr. Dean has provided the room for both purposes, although in doing so he makes the boiler more expensive, and causes it to occupy more space. The use of an internally combustion chamber 8 ft. high is a good feature, as far as securing the combustion of the gases is concerned, but it is a question whether a fire brick structure of the same height would not have been better as well as cheaper.

Messrs. Dean & Main are the engineers for the entire factory, in which two of their boilers are located, space being reserved for a third. They have also designed an engine for it of the vertical cross-compound condensing type, with gridiron valves, built by the Portland Co., of Portland, Me. The steam plant contains, with the boiler and engine, a Green economizer, two dynamos, one for lighting and one for power, and the necessary pumps, condensers, etc. There is also a complete refrigerating plant, 65 tons capacity, of the ammonia absorption type, built by the Hendrick Mfg. Co., Ltd., of Carbondale, Pa. This is used for cooling the air which is blown into the chocolate room and also for cooling the drinking water used in the factory. The machinery and elevators are driven by electric motors.

THE LATEST NORTH GERMAN LLOYD PASSENGER STEAMER.

The "Kaiser Friedrich," of the North German Lloyd Co., arrived in New York on June 16, after a voyage delayed somewhat by troubles with her new machinery. The maiden trip from Bremen to this port was made in 7 days, 10 hours, 25 minutes, and the daily runs were 290, 406, 442, 395, 472, 378, 460 and 320 knots to Sandy Hook. She was designed for a half-knot better speed than her sister-ship, the "Kaiser Wilhelm der Grosse," which has maintained an average speed of 22.35 knots across the Atlantic. But on this trip of the "Kaiser Friedrich" the port engine was stopped for 20 h. 26 m., and the starboard engine for 11 h. 42 m.; the result was an average hourly record of only 17.73 knots. This reduced speed is stated to have been caused by some of the main slide valves of the engine cutting. The vessel will return at half-speed, starting June 25, and some alterations will be made at the works of her builders. The "Kaiser Friedrich" was built in the yard of F. Schichau, in Danzig, and although of slightly smaller dimensions than the "Kaiser Wilhelm der Grosse" she is still equal in size to the largest steamships of any other nation.

The length of the "Kaiser Friedrich" is 600 ft. over all, her breadth is 64 ft., and her depth from the keel to the side of the upper deck 41 ft. Her gross measurement is 12,000 tons as against the register tonnage of 14,350 of the "Kaiser Wilhelm der Grosse." Her displacement loaded to 28 ft. draught is 17,000 tons. She has been provided with large bilge keels.

The hull and engines have been built under the rules of the Germanic Lloyd for the highest class of a four-deck ship. A double bottom extends the entire length of the vessel for water ballast and the hull is divided into 18 water-tight compartments by 17 bulkheads, of which 15 extend to the upper deck and two to the main deck. Should three adjoining compartments of these fill with water the steamer would still retain sufficient buoyancy to float. Twenty-two lifeboats, besides a number of collapsible boats, are placed on the awning deck ready for use.

The steamer has been built with special regard to the requirements of the Imperial German Navy, and can accommodate a large number of guns to be placed on board if the steamer should be required by the German Navy as an auxiliary cruiser.

The seamen are placed forward in the forecastle, and next to them, on the main and lower decks, are well-ventilated apartments for 750 steerage passengers. The entire middle part of the steamer is appropriated to the first cabin passengers, and the after part to the second cabin.

There are 180 staterooms provided for first cabin, accommodating about 350 passengers. The decoration of all the first cabin apartments are as remarkable for their elegance as those on the "Wilhelm der Grosse."

The second cabin passengers are berthed in 111 comfortable rooms, of which the larger number are arranged for two passengers. The crew of this steamer consists of 400, of which number 184 belong to the engine department and are, therefore, berthed in the immediate neighborhood of the engine room. The engineering department includes 1 chief engineer, 16 engineers, 11 assistant engineers, 3 greasers, 9 head firemen, 69 stokers, 72 trimmers, 1 boilermaker and 2 storekeepers, or a total of 184 men. The firemen and coal passers have their own dining room, and a special deck house has been built for them on the awning deck, where they are able to enjoy the fresh air even in bad weather.

The motive power consists of two quadruple-expansion engines of about 25,000 I. HP., which actuate two bronze propellers of three blades each, and a diameter of 20 ft. 4 ins., and a pitch of 28 ft. The engines have been placed amidship. Each engine consists of five steam cylinders working on three cranks. The crank and propeller shafts are constructed of Krupp nickel steel. The latter being 23.62 ins. diameter and made in 3 sections. The starboard shaft is 244 ft. long, and the port 247 ft. long. The cylinder diameters are 43¼ ins., 64¼ ins., 92½ ins., and two low pressure cylinders of 93¼ ins. each. The high pressure cylinder is placed above the low pressure, the second intermediate is in the centre, and the two other cylinders are at the other side, one above the other. They are carefully proportioned to give about the same horse-power each. The steam mains are 15-in. steel pipes, and the exhaust mains 36-in. copper. The piston rod for the high pressure cylinder is 11½ ins. in diameter, the connecting rod is 12½ ft. long, 10 ins. in diameter at the top and 11¾ ins. at the bottom. The stroke is 5½ ft., and the full speed about 85 revolutions per minute.

Steam is generated at 220 lbs. in 9 cylindrical Scotch double boilers, and one single boiler, placed in three groups, each in one water-tight compartment, and altogether having a heating surface of 75,000 sq. ft., and 73 furnaces. The furnaces are provided with Howden's forced draft. The coal bunkers have a capacity of 3,750 tons of coal, and it is expected that about 420 tons will be used each 24 hours. In order to place the engines amidships, it was necessary to put one of the three boiler groups aft of the engine room, an arrangement which, although introduced successfully on torpedo boats, has so far not been adopted on a large passenger steamship. Each of the three boiler groups is connected with one smokestack.

The lighting plant consists of 4 direct connected units, running at 280 to 300 revolutions per minute, each furnishing 600 amperes at 100 volts. The two distilling plants have a capacity of 45 tons each 24 hours. The ammonia refrigerating apparatus is used to cool 4 rooms each, of about 25 cubic meters capacity, in which all perishable food is kept.

Another interesting feature is the extensive pumping outfit. Of the larger sizes there are some 12 or 13, with a total output of 3,560 long tons per hour or approximately as much water as could be placed in a 50-ft. cube. The following is a list of these pumps:

2	2,700 tons per hour.	3	100 tons per hour.
2	60 " " "	1	240 " " "
2	80 " " "	1	40 " " "

All in all the "Kaiser Friedrich" is a model of the shipbuilders' art, and there is little reason to doubt its ability to meet all the exacting requirements of the owners, the North German Lloyd Co.

WEATHER TABLE FOR MAY, 1898. (Furnished to Engineering News by the Department of Agriculture.)

	Stations.	Temperature. (Degrees Fahrenheit.) Average.	Max.	Min.	Range.	Wind. Velocity in miles per hour. Average.	Max.	Direction at time of max. velocity.	Precipitation—rain or melted snow—inches. Total.	Heaviest in 24 hours.	No. of rainy days.
Northern Cities.	Northfield, Vt.	51.8	75	27	48	9.3	34	N	2.10	0.72	12
	Portland, Me.	52.6	79	35	44	7.6	30	S	2.62	1.03	13
	New York City	56.6	86	38	48	10.5	40	NE	5.55	1.60	21
	Pittsburg, Pa.	63.2	86	40	46	5.6	25	S	3.99	1.18	14
	Chicago, Ill.	56.2	79	37	42	17.2	48	W	2.23	0.52	13
	Omaha, Neb.	61.2	87	39	48	7.7	38	SE	4.33	1.16	13
	St. Paul, Minn.	58.1	84	38	46	7.5	24	NW	3.40	1.56	10
	Duluth, Minn.	50.7	80	35	45	9.3	33	NW	3.30	1.30	8
	Bismarck, N. Dak.	53.0	84	28	56	9.4	33	W	2.65	1.34	8
	Average	55.9	82	35	47	9.3	34	—	3.35	1.16	12
Southern Cities.	Washington, D. C.	64.4	91	36	55	6.2	25	N	3.60	1.24	14
	Louisville, Ky.	67.8	89	33	56	8.7	41	SW	4.22	1.72	10
	St. Louis, Mo.	67.1	90	41	49	9.5	62	SW	8.55	2.13	16
	Savannah, Ga	76.0	101	48	53	8.4	30	W	1.01	0.82	4
	Kansas City, Mo.	64.6	89	40	49	7.7	40	S	7.69	2.37	16
	Jacksonville, Fla	76.5	97	52	45	7.9	37	NE	1.81	0.90	5
	Chattanooga, Tenn.	71.8	94	42	51	6.9	33	NW	0.61	0.17	7
	New Orleans, La.	75.4	93	53	40	8.2	33	N	0.02	0.01	2
	Memphis, Tenn.	73.1	89	46	43	9.2	48	NW	4.39	1.83	8
	Palestine, Tex.	73.8	90	46	44	7.8	23	S	3.24	2.86	4
	Average	71.0	91	44	48	8.0	37	—	3.51	1.40	9
Western Cities.	Helena, Mont.	49.4	77	30	47	7.5	36	SW	4.88	1.51	17
	Port Angeles, Wash.	51.0	77	35	42	6.1	26	W	1.22	0.46	9
	San Francisco, Cal.	52.6	63	46	17	—	36	SW	1.44	1.23	8
	Salt Lake City, Utah.	53.9	80	32	48	6.1	37	SW	4.19	0.89	14
	Santa Fe, N. Mex.	—	—	—	—	—	—	—	—	—	—
	Denver, Colo.	53.0	80	27	53	7.5	38	S	4.88	1.25	16
	Yuma, Ariz	—	—	—	—	—	—	—	—	—	—
	Average	52.0	75	34	41	6.8	35	—	3.32	1.07	13

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After being in existence over ten years, the pneumatic high-explosive thrower "Vesuvius" has at last had an opportunity to test her equipment in actual warfare. In these ten years she has had a varied experience of official tests, and the reports of experts were all practically against her. Owing to the fixed position of her guns, requiring the vessel to be turned towards the object aimed at, it was supposed that the "Vesuvius" could only be used in still water; her limited range, high-angle fire and considerable size—929 tons displacement, were also an objection; as being unarmored, it was contended that she would be riddled by rapid-fire guns before she was in a position to do any harm. Finally, in the Port Royal tests, while her accuracy of fire was established, the fuses used very generally failed to explode the charges, and it was decided that she was a practical failure as a war-engine, and orders were actually issued to take out her dynamite guns and convert her into a torpedo boat. Owing mainly to the active interest of Assistant Secretary of the Navy Theodore Roosevelt, this was not done, and when the present war broke out the "Vesuvius" was added to the fleet of Admiral Sampson. Now, contrary to the expressed views of her critics, the "Vesuvius" has successfully tested her ability to safely throw 500-lb. charges of gun cotton into an enemy's works, and to do this from the open sea, where there must at least have been a considerable swell. Just what execution has been done by the six shots so far sent ashore, there is, at present, no means of discovering; but five of these six were heard to explode, and if any enemy were in the neighborhood of that explosion somebody was hurt. The chief point made is that pneumatic guns have been, for the first time, successfully used in naval warfare; and while this fast but unarmored boat is yet exposed to the chances of destruction from any well-handled battery, a wide field of usefulness is still open to guns of this type. For exploding submarine mines in a channel, in destroying fortifications too high for the fire of ordinary ship's guns, and for use against ships in harbor protection, high explosives thus accurately and safely ejected, in large quantities, introduce a new and terrible element into warfare.

The approval by the Navy Department of the sentence of Mr. A. G. Menocal, C. E., U. S. N., will be noted with deep regret by Mr. Menocal's many personal friends. Many of these friends still hope that the sentence is a formal one, and that he will be restored to duty before he reaches the limit for retirement for age, and will thus avoid a more lasting punishment than the finding of the court intended to inflict upon him. The conditions surrounding the building of dry-dock No. 3 were somewhat peculiar, and officials higher than Mr. Menocal in the service of the government are first responsible for imperfect plans and then for letting this dock to incompetent dock-builders. No one can deny that much rascally work was done in connection with this dock; and while the imperfections of the parts uncovered by Naval Constructor Bowles are well known, there will always be the uncomfortable feeling that more faulty work still remains hidden, ready to uncover itself, perhaps, under conditions exceedingly unfortunate for the government. In other words, even with the costly repairs performed by Mr. Bowles around the entrance, this dock can hardly be trusted with the weight of a heavy and costly ship. For this bad work, Mr. Menocal, as the engineer officer in charge, is technically and actually responsible, and from that point of view his punishment for neglect of duty is proper and just. But eight out of nine members of the court martial recommended clemency owing to the absence of Mr. Menocal at frequent intervals from sickness, and to the imperfect provisions and wording of the contract. These are mitigating circumstances; but we do not believe that the other excuse advanced—of "poor assistance," has as much weight. No one should know better than Mr. Menocal just how much assistance and inspection were wanted in such a case; and if he did not obtain what he needed it was his duty as an engineer to put that fact upon record for his own sake. We happen to know of a certainty that for a time one inspector, on dry-dock No. 3, was made responsible for overseeing the making of concrete at one point and its deposit at another point, several hundreds of feet away. If similar "inspection" was the rule in driving piles about this dock, the substitution of 4-ft. "stumps" for 40-ft. piles is not so remarkable. No engineer or inspector can be in more than one place at a time, and no one expects the engineer in charge to do all his own inspecting. But given a scamping contractor (and this the engineer in charge should be able to detect at an early stage of the work), it is all important that the inspectors selected should be honest and rigid in their inspection; and upon this the engineer should insist. If political appointments, too common about government dock yards, prevented the engineer from securing the right sort of men for inspectors, the only safety for the engineer is to make this fact known by exceeding vigilance on his own part. In this case we believe that Mr. Menocal was, first, the victim of faulty plans and specifications, and then of a rascally contractor, and of inspectors appointed because of their political pull. The conditions of an existing war, the pressing need for the dock for purposes of that war, and, possibly, the late mishap of Mr. Menocal in the case of a wrecked caisson-gate, all combined to increase the certainty of a verdict of guilty in this case. We personally regret that Mr. Menocal, or any other member of the Engineer Corps of the Navy, should find himself compelled to defend himself against such charges; but there is a wholesome warning in the case, and the verdict appears to have been the only one possible under the circumstances.

The application of the New York and New Jersey Bridge Co. to the Commissioners of the Sinking Fund for power to use West street as an approach to the proposed bridge across the Hudson, has developed vigorous opposition from the Rapid Transit Board and the Manhattan Elevated Railway Co. The New York end of this bridge was definitely located at 59th St., by a commission appointed, with a curving approach southward down Eleventh Avenue, and then to 49th St. and Broadway to a Union passenger station. After this line was fixed and approved by the Secretary of War and the Sinking Fund Commission, the bridge company conceived the idea of making an elevated "freight approach," which was to extend 4½ miles from 59th St., along the marginal wharf of West St., to the Battery. This latter is the line now in controversy; and as the New York Central Railway Co. has persistenly fought the bridge company from the beginning, this corporation may also be expected to take a hand at the proposed appropriation of West St.

The contention of the bridge company, as voiced by Mr. Andrew H. Green, is that this extension would be used by all the railways having terminals in Jersey City and Hoboken; that it would save largely in the transport of freight across the river, and that it was absolutely essential for the maintenance of the commercial supremacy of the port of New York. Mr. Green quoted freely from the reports of the board of consulting engineers appointed by the late Dock Board, in support of his position and the necessity for just such a railway. But, as we remember that report, an elevated structure was deemed unadvisable by the consulting engineers referred to, for all purposes of foreign and domestic commerce, and a surface railway was decided upon, located on the river side of West St. Besides this, the position taken by the board of engineers in regard to the actual utility of this surface railway, in the transfer of freight between ships and railways, was so vigorously and successfully assailed by Chief Engineer Buchholz and others that it still remains for the board of consulting engineers to disprove the charges made against their proposition. The Rapid Transit Board objects to the appropriation of this line by the bridge company because it was not consulted, and its franchise-granting power was ignored; and the Manhattan Elevated Co. demands a hearing because it is now negotiating with the Rapid Transit Board for an extension of its elevated system on this same street. As the matter stands, both the Rapid Transit Board and the Manhattan Co. are to have an opportunity to present their case before any decision is arrived at.

As to the interests of the general public in the matter, the citizens of New York may console themselves with the reflection that the affairs of the bridge company have progressed so slowly, if they have progressed at all, that there is very little prospect of the materialization of the West St. elevated "freight approach" under any circumstances. At the same time, the needs of the traveling public can be served by the establishment of a passnger service on this route, and no action of the Sinking Fund Commissioners should be permitted to interfere with this prospect. The commercial needs of this port can best be met by the building of more large and convenient docks, and the reduction to some system of the heterogeneous assortment of old piers and landings and narrow streets now in existence along the East River water front. With spacious and well-arranged piers and a wider marginal street, taken in connection with an already excellent plant for the transfer of freight to and from ships on the water side, the facilities of this port would be very largely increased. The North River front of New York is very unhappily located for the purposes of any rail connection with the trunk lines on the other side of the river; and an elevated structure along West St., even with four tracks, would be more likely to add to the confusion of freight transfer than to in any way better existing conditions.

In our issue of April 21 we published three letters from Robert Fulton to Messrs. Boulton & Watt, written in 1794, 1803 and 1804, relating to the steam machinery for Fulton's steamboat, the "Clermont." These letters were read before the Institution of Naval Architects by Sir Frederick Bramwell as a discussion of a historical paper by Chas. H. Haswell (Eng. News, May 19). Sir Frederick also showed the members a time-bill of the steamers "Raritan" and "Phoenix" from Philadelphia to New York. We are enabled, through the courtesy of Mr. J. H. Morrison, who was for many years associated with the late Geo. M. Copeland, M. Am. Soc. M. E., to give some further particulars of the "Raritan." As noted above, this steamer plied on the route between New York and Philadelphia, running from New York city down New York Harbor and Bay to Amboy, N. J.,

on the Raritan Bay. The rest of the journey was performed by land, at first by stage-coaches and later by the famous old Camden & Amboy R. R. Mr. Morrison writes as follows:

Sir: The "Raritan" was constructed at New York city in 1808 by Charles Brower, who had the previous year built the "Clermont" for John R. Livingston and Robert J. Livingston. Attached to the drawing for the vessel were Robert Fulton's instructions for the building of the vessel under date of Oct. 22, 1808, in these words in part:

As you will have more and greater waves than the North River boat, the wheel guards must be so constructed that the head of the wave will not strike under them; I would finish them as here delineated. * * * *

Robert Fulton.

I think these facts will establish clearly the date of building the vessel.

Yours truly,

J. H. Morrison.

358 Hancock St., Brooklyn, May 28, 1898.

WANTED: FASTER BATTLESHIPS.

The Board of Construction of the Navy Department has decided that the three new battleships just provided for by Congress shall have speeds of only 15 to 16 knots. Commodore Melville, Chief of the Bureau of Steam Engineering, and a member of the Board of Construction, submitted designs for propelling machinery adapted to give these vessels a speed of 18 knots; but these designs were rejected by the Board, and notice to bidders has already been issued by the Navy Department to prepare plans for vessels of the speeds named above.

In taking this action, it seems to us that the Board of Construction have made a serious error, and one of too much public importance to be passed over without notice. If it is worth while for the taxpayers of the United States to go down into their pockets for some fifteen million dollars, to add three new battleships to their navy, it is surely worth while to see to it that these vessels shall be equal or superior to any similar vessels afloat or under construction for European navies.

The American public is taking a far greater interest in naval matters this year than it has ever taken since the gallant exploits of 1812. If it is once clearly understood that the three newest battleships for which its representatives have appropriated funds are to be from two to four knots slower in speed than the latest European battleships, a general protest will certainly be heard against the decision of the Naval Construction Board.

It ought not to be necessary, in the light of the events of the past month, to explain to any American reader the enormous advantages of high speed in naval warfare. Had Spain's Cape Verde squadron of 20-knot armored cruisers been able to take in a full equipment of coal and supplies at any port on this side of the Atlantic and then start out on a cruise, we should have had an illustration and a pretty costly one of the value of high speed. We do not mean that they could probably have done any very serious damage to coast towns; but they could have done an amount of injury to our naval vessels and our shipping of most serious proportions. Let it be remembered that out of the entire United States Navy of over 200 vessels, we have only seven (aside from the monitors) whose guns and armor are sufficient for them to engage such vessels as the "Vizcaya" with any chance of success. Of these only two have speeds equal to those of the Spanish cruisers. Further, we have in our whole navy only six vessels, all told, with speeds approaching theirs, and four of these have not armor enough to engage them. Had Cervera's vessels once got a chance with full coal bunkers to sail along the Atlantic coast, practically our whole navy and all our coast shipping would have had to seek refuge in harbors to escape capture, and our slow-speed battleships would have been powerless to catch and punish the invaders.

By the most able generalship on the part of our naval commanders we have been fortunately delivered from a situation fraught with more peril than one American citizen in ten thousand realizes. But although we have been spared from learning in the dear school of experience what superior speed means in naval warfare, we have come so near to the brink that we shall be fools beyond measure if we do not take immediate steps to see that we are not again caught in so risky a situation.

This journal has repeatedly called attention to our great need of fast armored cruisers, yet none whatever have been provided for in the Naval Appropriation bill. Instead, we have three more battleships to add to the four already in commission, and the five which are now under construction, and these new vessels, as we said above, are to be far inferior in speed to the latest battleships of European countries.

The only excuse thus far published by the Board of Construction for turning down Commodore Melville's designs for 18-knot vessels is that these designs would necessitate changing the plans for the interior construction of the vessels considerably, and thus postpone by several months the date of letting the contracts, and the time of completion of the vessels. This excuse, however, seems to us far from sufficient. We are now at war with a European power and getting along fairly well with only four battleships of the first class. With the five more which we have now well advanced toward completion, we are at least not so badly off that we can afford to take an inferior article for the sake of getting it a little sooner.

We have alluded above to the speeds of recent foreign battleships. It may be interesting at the present time to see just what foreign nations possess in the shape of fast battleships. Turning first to England, which leads the world in naval construction, we find that the latest type of battleship which her naval constructors have developed are expected to have speeds appoaching 19 knots. Six of these great vessels, the "Canopus," "Goliath," "Ocean," Albion," "Glory" and "Vengeance" are now nearing completion. They have a displacement of 12,950 tons and triple expansion engines of 13,500 I. HP. These vessels are very similar to the famous "Renown," a battleship of 12,350 tons, which was launched in 1895. The "Renown" has engines of 12,000 I. HP., and on her four-hours' run under forced draft showed an average speed of 18.75 knots, developing 12,900 HP. In an 8-hour run under natural draft she averaged 17.9 knots, with 10,708 HP.

The "Magnificent," "Majestic," "Mars," and "Jupiter," form a quartette of huge vessels of 14,900 tons displacement. Each of them has engines of 12,000 I. HP. These vessels had their trial trips in 1895 and 1897. The horse-powers and speeds were as follows:

Vessel.	I. HP. Natural draft.	I. HP. Forced draft.	Speed, knots per hr. Natural draft.	Speed, knots per hr. Forced draft.
"Magnificent"	10,301	12,157	16.5	17.6
"Majestic"	10,418	12,497	16.9	17.9
"Mars"	10,159	12,434	16.9	17.7
"Jupiter"	10,248	12,475	15.8	18.4

The "Prince George," Victorious," Caesar," "Hannibal," and "Illustrious," are of the same displacement and horse-power as the four above-named, and have practically the same speed. These nine vessels are the largest naval vessels afloat, except Italy's "Italia" and "Lepanto," the latter of 15,900 tons displacement. Great Britain is now building three more battleships with the same displacement as the vessels of the "Majestic" class, and they are planned for even greater speed, 18.75 knots.

All the vessels named above have been launched or put under construction within the past five years. Among the older English battleships, however, we find no less than ten with nominal speeds of 17.5 to 18.2 knots. In fact, not since 1885 has an English battleship been launched, designed for a speed below 16.7 knots.

It is of interest to note that the "Iowa" is the only one of our own battleships which reached a 17-knot speed on her contract trial. Our five new battleships now building are each to have a displacement of 11,525 tons and a nominal speed of 16 knots.

Turning next to France, the second naval power of the world, we find that she has at least eight battleships with speeds in excess of any United States battleships. The "Charles Martel," a 11,-900-ton battleship, on her four-hours' speed trial, in May, 1897, made a speed of 18.13 knots, with 15,000 I. HP. The "Jaureguiberry" and the "Carnot" are two other battleships each of 11,800 tons which had their steam trials in the spring of 1897. The former made 17.65 knots, and the latter 17.9 knots on the average with a maximum of 18.5 knots.

The "Charlemagne," "Saint Louis," and "Gaulois" are battleships of 11,000 tons, designed for a speed of 18 knots. The "Massena," launched in 1895, is a triple-screw battleship with engines of 13,500 I. HP., designed to give a speed of 17.5 knots. The "Bouvet," launched in 1896, is a sister vessel to the "Massena."

Germany, as many of our readers will recall, is taking up the matter of naval construction in a vigorous way, and as a German shipyard has built the two fastest transatlantic liners afloat, we may be sure that her new naval vessels will not lack in the matter of speed, whatever her old-style ships may have done. The "Kaiser Friederich III.," launched in July, 1896, is a triple-screw battleship of 11,050 tons, with engines designed to give 13,-000 I. HP., and a speed of 18 knots. The new "Kaiser Wilhelm II.," launched last year, and the "Konig Wilhelm," under construction at Kiel, are sister vessels with the same displacement and speed as the above.

Italy, notwithstanding her poverty, has a naval force of no mean proportions. The "Ammiraglio di St. Bon," a 9,800-ton battleship, was launched a year ago, and is designed for a speed of 18 knots. The "Emanuele Filiberto" is a sister vessel with the same dimensions. The "Sicilia" is a battleship which had her steam trials in 1895, and is reported to have made an average speed of 19.3 knots under natural draft alone. The "Sardegna" is a battleship of 15,000 I. HP., which in her contract trial, four years ago, made an average speed of 19.64 knots.

The "Re Umberto," launched ten years ago, has a speed of 18.5 knots, while the gigantic "Lepanto," now 15 years old, has a nominal speed of 18.4 knots.

Russia has three battleships, launched in 1894 and 1895, the "Poltava," "Petropavlosk" and "Sevastopol," which are each of 10,960 tons displacemept with engines of 13,500 I. HP., designed to give a speed of 17.5 knots. That these speeds for Russian vessels are not overestimated by their constructors seems evident from the fact that the Russian battleship, "Tri Sviatetelia," in a 12-hours' speed trial attained a speed of 18 knots, although her contract called for only 16 knots. The newest Russian battleship, for which orders have recently been placed with the Cramp shipyard in Philadelphia, is to have a speed of at least 18 knots.

Japan has two English-built battleships, the "Fuji" and "Yashima," launched in March, 1896, each of 12,320 tons displacement, with propelling machinery of 13,500 I. HP., designed to give a speed of 18.25 knots.

It will be seen by the preceding hasty review, that *there are at least FIFTY battleships already afloat or under construction which have speeds one to three knots in excess of the speeds of any battleships of the United States.*

During the decade from 1880 to 1890, speeds of 15 to 16 knots were generally accepted as standard speeds for battleships the world over. At the present time speeds of 17 to 19 knots are equally accepted as the standard for battleships by the principal naval powers. Not one of these powers would think at the present time of building first-class battleships for any lower speed. To do so would not only result in a vessel of obsolete type, but would seriously injure the naval prestige of any power.

In the face of this action, by all the other naval powers of the world, our own naval authorities have adopted a course which may result in the three new battleships for which contracts are about to be let being even slower than those now in commission. When the "Indiana," "Oregon," and "Massachusetts" were built, the contractors were offered a premium for securing high speed, and the "Oregon," which was designed for a speed of 15 knots, actually made 16.79 knots in her contract trials. But as the result of a clamor, started for political effect, Congress has forbidden giving premiums for high-speed. The Navy Department, in its circular to shipbuilders, announces that the new battleships will be accepted if they reach a speed of only 15 knots on their contract trial. The contractor is subjected to a moderate penalty for each quarter knot deficiency in speed below 16 knots; but he has no incentive whatever to build a vessel

that will do better than 16 knots, and there is no reason to expect that he would do it.

We have always contended that the withdrawal of speed premiums to builders of naval vessels was a piece of penny-wise economy. Those who brought it about prated about the saving made in the amount of the premium and wholly forgot that the shipbuilder, in making his original bid, took into consideration the amount of speed premium that he could fairly count on receiving. Further, the speed made in the contract trial run of four hours is no such false index of the speed under service conditions, as has been claimed. No better proof of this could be given than the magnificent voyage of the "Oregon," and the high speed records which she made after cruising ten thousand miles and with engine and fire-room forces suffering from the heat of the tropics.

Turning again to the speed requirements for our newest battleships, it should be noted that the Bureau of Steam Engineering is not at fault. They have offered plans for 18-knot vessels, involving the latest types of water-tube boilers and quadruple expansion engines, and promising a saving of weight of 350 tons. Every other naval power in the world of any importance is making extensive use of water-tube boilers. We cannot ignore the progress of other countries and placidly say that what has been used in the past is good enough for us, if we propose to make good the international obligations which we are undertaking.

We are aware that the adoption of water-tube boilers has caused a vast amount of criticism in foreign navies, and experiments with them in this country in marine service, have not been an entire success; but other countries have not abandoned the use of these boilers on account of the difficulties. Instead, they have gone on to improve and perfect them. Surely, if Frenchmen and Italians and Russians can adopt and use these boilers, Americans, with their well-won reputation for mechanical skill, can do at least as much.

We are aware, also, that in the past the theory has obtained in Congress, and possibly to some extent in the Navy Department as well, that our navy was to be designed solely for defence, and that low speeds and small coal capacities were all right for American naval vessels. The fallacy on which this assumption rests has been well shown of late by that acknowledged authority on naval strategy, Capt. Mahan; and in the light of the object lessons of the past two months, it hardly seems possible that it can enter as a factor into the design of our newest battleships. It ought to be plain to everyone now that attack is the best defence, and that the policy of building monitors, which, by good rights, ought never to be sent to sea at all, and expecting our gallant admirals to tow them along when they go gunning for 20-knot cruisers is a policy that ought to be laid on the shelf. The nation will not be satisfied with a navy for coast defence, merely, but demands that our vessels shall have speed enough and strength enough to protect our commerce on the high seas.

American shipyards are building vessels for the navies of Japan and Russia. If they can build 18-knot battleships for the latter country, they can do it for our own, if our naval authorities will only require them to do so.

Finally, let it be understood that in the criticism we have made, we are expressing no opinion as to the wisdom of increasing the size of our navy. We are by no means inclined to join in the popular clamor which urges that we compete with the greatest European nations in our naval establishment. What we do urge is that the weak places in our naval forces which the present war has brought to public attention, shall be strengthened, and that every new vessel we build shall be at least as good in every respect as the latest vessels of its type abroad. We have no hesitation in saying that if our new battleships cannot be placed at least on a par with the best of foreign navies, it will be better for the reputation of the United States navy not to build them at all.

LETTERS TO THE EDITOR.

Positive Blue Prints.

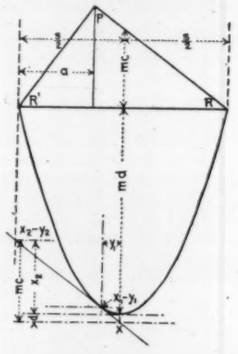
Sir: Noticing in the current issue of your paper a communication on positive blue prints I would say I am making use of a paper known as the "Vandyke" black process paper, costing $2.10 per 10-yd. roll of 36-in. wide paper. The negative print is made in the general manner described by Mr. Isaacs, the print then washed same as a blue print, then taken from the bath and brushed over with a solution of "Vandyke salt" (a box of the salt accompanies each roll of paper) and washed again.

The positive prints can, of course, be made on the same paper or on blue-print paper. My best prints have been made on "Keystone" blue-print cloth. I think this process cheaper than that of Mr. Isaacs. Yours truly,

Rockland, Me., June 10, 1898. O. H. Tripp.

A New Moment Formula for Concentrated and Distributed Loads.

Sir: I give below a simple, and I think an original, formula for quickly locating the point of maximum moment in a beam supporting one concentrated load, and an uniformly distributed one, which I have found very convenient in practice, and which I trust some of your readers will find equally useful. It consists simply of multiplying the concentrated load by its distance from the nearest support, and dividing by the distributed load; the result being



the distance of the point of maximum bending moment from the center of the span, when it lies between the center and the point of application of the concentrated load.

In the graphical diagram, the moments due to the concentrated and distributed loads at any point are represented, as usual, by the lengths of perpendiculars to R R' in the triangle R P R', and the parabola respectively; the maximum moment from the combined loads being, of course, the longest perpendicular to R R' which can be drawn within the figure R P R' X; the separate moments being reduced to the same scale. This total moment is evidently at the point of tangency of a line parallel to P R, and the parabola.

Let S = span; m c = moment at center of span, due to concentrated load; m d = moment at center of span, due to distributed load; a = distance from nearest support to concentrated load; P = concentrated load; w = distributed load; y_1 = distance of maximum moment from center of span. But the distance of a point of tangency, $x_1 - y_1$, from axis X of a line from an external point $x_2 - y_2$, to parabola $= y_2 + \sqrt{y_2^2 - 2 p x_2}$. Make (m d) of such scale that it equals S = 4, for a constant parabola $\left[p = \frac{1}{2}\right]$, then from

$$y_2^2 = 2 p x, \left[\frac{S}{2}\right]^2 = x = m d;$$

and from $y_1^2 = 2 p x_1$, $x_1 = y_1^2$, or $x_2 = m c - d = m c - y_1^2$. Therefore,

$$y_1 = \frac{S}{2} + \sqrt{\left[\frac{S}{2}\right]^2 - m c + y_1^2}.$$

$$\left[y_1 - \frac{S}{2}\right]^2 = \left[\frac{S}{2}\right]^2 - m c + y_1^2; \quad y_1 = \frac{m c}{S} = \frac{m c}{m d}.$$

But $$m c = \frac{P a S}{2 S} = \frac{P a}{2}; \text{ and } m d = \frac{w S}{8}.$$

Therefore, $$y_1 = \frac{P a}{2} \div \frac{w S}{8} = \frac{P a}{w};$$

which is true to the limit where $y_1 > \frac{S}{2} - a$, in which case the maximum moment is at P.

Fred W. Lepper, Structural Engineer,
Office Henry Ives Cobb, Architect U. S. Government Building at Chicago, Ill.

Treasury Department, Washington, D. C., May 24, 1898.

Applying Brake-Shoes Below the Center of Car Wheels.

Sir: In railway cars, coaches, tenders, etc., brake-shoes are usually applied to the wheel below its center. Can you tell me why this is so and why they might not be applied half way up on the wheel or even above its center? If the brake-shoe is more effectual when applied below the center, please explain why this is the case.

Yours truly, B. A. Ludgate,
Texas Midland R. R., Engineering Department.

Terrell, Tex., June 9, 1898.

(We referred the above query to Mr. R. A. Parke, of the Westinghouse Air Brake Co., who has kindly furnished us the following reply.—Ed.)

Sir: I beg to acknowledge receipt of your favor enclosing a communication from Mr. B. A. Ludgate. In reply to the latter it may be said that, in some cases—notably, four-wheeled coal "jimmies"—brake-shoes have been applied to the wheels above their centers; in fact, in the case specifically referred to, they have been applied at the top of the wheels. In such cases, however, the pressure of the brake-shoes upon the wheels appears to have been a moderate one and power brake apparatus was not employed.

There is an objection to the application of brake-shoes above the center of the wheels in any case where the brake-shoe pressure is sufficient to insure good braking efficiency. When the brake-shoes are applied below the centers of the wheel, the pressure of the brake-shoe upon the wheel can be resolved into horizontal and vertical components. The horizontal component tends to force the journal of the axle out from underneath the journal bearing; while the vertical component increases the pressure between the journal bearing and the journal, thereby tending to prevent the dislodgment of the journal. When the brake-shoe is applied above the center of the wheel, the vertical component of the brake-shoe pressure tends to lift the truck frame from the journals, and the liability to dislodgment of the journals is considerable.

The writer had occasion to investigate the causes of serious trouble arising from hot boxes on the passenger cars of a railroad. It was found that the journal bearings were more or less tilted during an application of the brakes and the waste in the journal boxes found its way between the journals and bearings, resulting in the subsequent heating of the journal. It appeared to some of the railroad officers that the trouble was due to the use of too great a brake-shoe pressure upon the wheels. Investigation revealed the fact that the brake-shoes were so hung that their centers were only an inch or less below the centers of the wheels. Upon lengthening the brake hangers so that the centers of the brake-shoes hung about 2½ ins. below the centers of the wheels, the trouble entirely disappeared without any modification of the pressure with which the brake-shoes were applied to the wheels. This instance fully illustrates the above-mentioned objection to the application of brake-shoes above instead of below the centers of the wheels. Very truly yours,

R. A. Parke.

26 Cortlandt St., New York city, June 18, 1898.

Revolving Lamps for Night Signals.

Sir: In your issue of May 19, 1898, p. 319, we find an artitcle entitled "A New Form of Railway Night Signal." Had this article been signed by the inventor or given individuality by any signature we would, of course, consider it only as the claims of the inventor, even though you made no editorial remarks on the subject. Since the article is not signed we assume that it is authorized by your editorial staff, and we are somewhat surprised to find that you have made no investigation in the art of signaling as connected with a revolving lamp, for had you done so you would have found that it was the very first form of signal used. It is described by Rapier on railway signals and by Barry, and has been used on most of the railways of England, and in 1890 the Old Colony installed semaphores with revolving lamps, as indicated in accompanying blue prints. These prints show the two lower lamps as being revolved. In the new form of railway signal which you describe it seems that no provision has been made for a back light, which is necessary in all signals operated from an interlocking cabin so that the signal may be observed by the signalman in cabin.

The partial illumination of the blade by locating the lamp so as to throw its rays across the field through which the arm moves has also been accomplished before. Perhaps the most elaborate test of illuminating the blade has been made by Prof. C. Herschel Koyl, in his parabolic semaphore, but notwithstanding that he used a lamp of special construction and faced the blade with a corrugated aluminum reflector the result was not satisfactory. Mr. E. C. Carter, Principal Assistant Engineer of the Chicago & Northwestern, has used the lamp to illuminate dwarf signals where practical, and, we believe, with excellent results.

Since we understand the purpose of your journal is to give accurate information so that your readers may place confidence in all statements made by you, we naturally expect that before making any statement of new discoveries in any art you would inform yourselves on the subject. As this article appears in your paper, it would lead any one not thoroughly familiar with the art to believe that some new and valuable discovery had been made and that the Engineering News was seeking to

bring it before its readers in order that they might receive the benefits of the information contained therein.

Yours faithfully, Charles Hansel.

Vice-President and General Manager, National Switch & Signal Co.

43 Cedar St., New York, June 16, 1898.

(Doubtless a search of the patent records would show that many of the devices brought forward from time to time as novel were either wholly anticipated or were merely improvements in detail on older devices. In the present case, we must confess our ignorance of the previous use of revolving lamps, to which our correspondent refers, and we are obliged to him for the information which he gives. We may remark further that in selecting new inventions for description and illustration in our columns, we are more particular as to the merit which a device may seem to possess than we are as to its absolute novelty. Our correspondent makes no criticism as to the merits of the device which we illustrated, except the omission to provide a back light. This, however, we should judge could be added with little difficulty.

We were aware of the experience with the Koyl parabolic semaphore; but if our memory rightly serves, in this device the illuminated blade of the semaphore was the only night signal. We do not attach great importance to the blade illumination claimed for the Kaski signal; but it might be of some value at dusk when both the red light and the semaphore arm are visible, but neither is very distinct.

We judge from Mr. Hansel's statements that the use of revolving lamps is in no sense new. If the advantages claimed for this form of signal are correct, therefore, engineers can make use of such signals when they desire without payment of royalty.—Ed.).

Notes and Queries.

C. I. M., Pittsburg, Pa., desires to learn some method of separating coal from sand in large quantities. The sand contains about 5% of coal, and both coal and sand will pass a No. 8 screen.

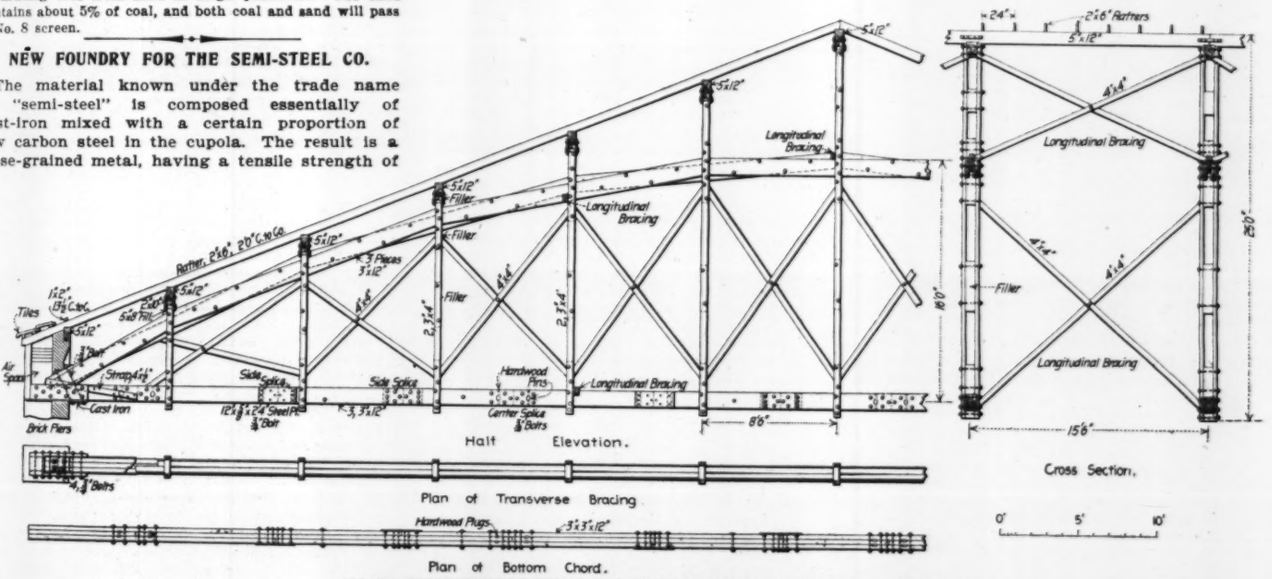
NEW FOUNDRY FOR THE SEMI-STEEL CO.

The material known under the trade name of "semi-steel" is composed essentially of cast-iron mixed with a certain proportion of low carbon steel in the cupola. The result is a close-grained metal, having a tensile strength of 35,000 to 40,000 lbs. per sq. in., and which can be easily machined. This metal is being used extensively for large gear wheels, cylinders, clutches, dies for drop forgings, heavy machinery castings, smelting kettles, ammonia cylinders, etc. These various articles are manufactured by the Semi-Steel Co. (the King & Andrews Co., proprietors), of Chicago, and the company is now erecting a new foundry plant at Chicago Heights, Ill.

All the plant is included in one large building, about 200 x 150 ft., with the exception of a separate pattern shop, 30 x 50 ft. The main casting floor is 200 x 100 ft. On one side of this, and extending a part of its length, is a wing about 28 ft. wide, one story high, containing the machine shop and carpenter shop. A similar wing, but two stories high, extends the full length of the building, on the opposite side. This contains the three cupolas; sand storage room, 4 ft. 9 ins.; boiler room, 36 ft. 7½ ins.,; engine room, 22 ft. 4½ ins.; core ovens, etc. A somewhat notable feature in the structure is that the cars with scrap, sand, etc., enter the upper floor of this wing by means of a trestle approach, the scrap and other supplies for the cupolas being stored on this floor, while the sand is dumped into chutes leading to the floor below. One end of the main floor will be devoted to molding and the other end to casting. No traveling cranes will be used, but the ladles will be handled by three steel jib cranes of 18 ft. and 24 ft. radius, two of these being of 50 tons and the other of 25 tons capacity. The brick smokestack is 75 ft. high and has an interior diameter of 3 ft. 6 ins.

There are six cupolas; three 84-in., two 72-in. and one 56-in., built by Kroschell Bros., from original designs. There is also an engine of 100 HP., steam for which is supplied by a horizontal tubular boiler; and both engine and boiler were built by the Atlas Engine Works. The plant has recently been put in operation.

The building is of brick, the side walls being 28 ft. high, and ample lighting is provided by large windows in the sides and ends, as well as by skylights. Cast-iron is used for the window sills and frames. The larger wing has cast-iron columns of H section, supporting a steel roof and a solid upper floor of steel I-beams with brick arches and concrete filling, wooden floor strips being embedded in the concrete. The H form of column was adopted, as with it the thickness of the metal is open to inspection. The main floor is, of course, covered with molding sand, while the machine shop, engine room, etc., have floors of wood. The roof over the main floor is supported by wooden bowstring trusses of 100 ft. span, one of which is shown in the accompanying cut. Each truss has 12 panels of about 8 ft. 6 ins., and is 16 ft. deep at the centre, the bottom chord being 26 ft. clear above the floor. The bottom chord is composed of three timbers 3 x 12 ins., in 24 ft. lengths, bolted together, and having iron splice plates on the outer joints, the inner joints being keyed, as shown. The arched top chord is also composed of three timbers 3 x 12 ins., built up to approximate to a curve. The vertical members are each composed of two timbers 3 x 4 ins., with filler pieces between, all bolted together. The diagonal members are sticks 4 x 4 ins. The main vertical timbers are outside of the chords and extend above the upper chord to carry purlins 5 x 12 ins., on which rest the rafters, 2 x 6 ins., for the roof. These trusses are set about 15 ft. 6 ins. apart, c. to c., and are connected by diagonal bracing. The roof covering is of asphalt, with skylights.



100-FT. WOODEN ROOF TRUSS FOR THE FOUNDRY OF THE SEMI-STEEL CO.
J. L. Silsbee, Architect.

The building was designed by Mr. J. L. Silsbee, architect, of Chicago, to whom we are indebted for drawings of the roof trusses. It was built by the Wm. Adams Co., of Chicago.

MANILA HEMP, which every engineer uses, but knows little else about, is the product of a species of banana (Musa textilis), and is cultivated in certain localities in the Philippine Islands. The plant, called "abaca" by the natives, throws up a cluster of sheathing leaf-stalks to a height of 20 or 30 ft., which spread out at the top into a crown of huge, undivided leaves. It is cut down when three years old, and the sheathing stalks are torn apart and reduced into strips. These strips, when fresh, are drawn between a knife and a wooden block, until, by continued scraping by the expert natives, the soft, cellular matter is removed, and the fiber is then hung up to dry in the open air until it is ready for use. Each stalk yields about 1 lb. of fiber, and two natives, cutting down and scraping, will produce only 25 lbs. per day. The fiber of the outer layer is hard and strong; that from the inside is fine, thin and weak, and is used by the natives in making articles of dress. The whole supply of Manila hemp practically comes from the Philippines, and the United States consume 41% of the export. In 1897, out of 825,028 bales exported, the United States took 417,473 bales; Great Britain imported 385,182, and the Continent of Europe, 22,373 bales. It is the most valuable of all fiber for cordage, as it possesses great durability and strain-resisting power. Manila rope is now frequently adulterated by an admixture of New Zealand flax and Russian hemp.

THE PARIS EXPOSITION OF 1900 has been reported upon by Mr. Thos. W. Cridler, Third Assistant Secretary of State, who succeeds the late Moses P. Handy as Special Commissioner for the United States. Mr. Cridler reports the buildings well under way, and says the following space has been allotted to the United States: In the Hall of General Manufacture and Household Furnishing, 24,390 sq. ft.; in Mines and Metallurgy, 7,690 sq. ft.; in Threads, Textiles and Wearing Apparel, 13,003 sq. ft.; in Agricultural and Fruit Products, 18,518 sq. ft.; in Education and Liberal Arts, 11,471 sq. ft., and in Chemical Industry, 5,160 sq. ft. He says that the Director-General of the Exposition asked if the American exhibitors would furnish 30,000 HP. of electric power to light the whole exhibition and run all the machinery; he found, from the applications for space in the electrical exhibit, that this could be done, and it was only a question of selecting the best. Mr. Cridler strongly advocates liberal appropriations for the Exposition, by the government, for purely commercial reasons. Congress has accepted the invitation to participate; and as we have raw products and finished goods to sell to the people of the world, it is only wise to make as representative and complete a display as possible to the people who will visit the exposition and who are prospective buyers.

A NEW INCANDESCENT LAMP REQUIRING NO vacuum bulb is said to have been invented by Professor Nernst, of the University of Goettingen, Germany. The incandescent portion is a thread 3 cm. long and about 5

mm. in diameter. It is also said that this lamp requires only 25 to 50% as much current as the present forms for a given candle power.

INSULATORS USED FOR HIGH TENSION TRANSmission lines are said to exhibit the peculiar property, during rainy weather, of drying themselves and thus preventing leakage of the current being transmitted. It is said that the static effect existing between the wire and the pole, cross arm and ground heats the insulator and prevents the formation of a thin sheet of water all over the under surface. The water runs off in streams or drops from the edges but does not creep over the under side of the insulator.

THE USE OF ELECTRIC LOCOMOTIVES for freight yard or general shifting purposes is becoming generally recognized. One of the latest examples of this class of service is afforded by the Arlington Mills, Lawrence, Mass. These mills have about two miles of track running from the main line of the Boston & Maine R. R. and spurs in the alleys between the different buildings. As formerly operated a steam locomotive was rented from the railway, but this was both expensive and unsatisfactory, and an electric plant was installed. This consists of a standard 75 K-W. 500 volt General Electric generator belted to an Armington & Sims high speed engine, and two cars, a flat car and a box car, the former equipped with two 50 HP. GE-1200 motors and series parallel controllers, and the latter provided with two 27 HP. GE-800 motors and controllers. Together they can haul 30 or 40 empties or 12 to 14 loaded cars. To increase the traction of the flat car it was loaded with a dead weight of about 6 tons. The new arrangement is resulting in a marked saving.

THE STANDARD FREIGHT-CAR TRUCK of the Missouri Pacific R. R. is an all-metal truck, formed by a combination of diamond frames and a cast-steel bolster. The side frames have upper and lower end bars $1\frac{1}{4} \times 4$ ins., and a tie-bar $\frac{3}{4} \times 4$ ins., the lower end bar supporting a cast-steel saddle which forms the seat for the coil springs. The frames are connected transversely by two flat bars $\frac{3}{4} \times 3$ ins., whose ends rest between the lower end bars and the tie-bars, being secured by the column bolts, which pass through them. The bolster is of cast-steel, of inverted trough section, 7 ft. 3 ins. long, 13 ins. wide, 9 ins. deep at the middle and 4 ins. deep at the ends. The column guides, center plate and side bearings are all formed in the casting. The top and sides are $\frac{5}{8}$-in. thick, and there are stiffening ribs around the top and along the inside edges of the sides. The trucks are manufactured by the American Steel Foundry Co., of St. Louis, Mo.

THE LONGEST ELECTRIC RAILWAY in the world is said to be that operated between Kenosha and Waukesha Beach, both in Wisconsin. This line is 62 miles long, and arrangements have been made by the Milwaukee Electric Ry. & Light Co. to run chartered cars from Milwaukee to Waukesha Beach. Commutation tickets, sold at a lower rate than the regular steam roads, and other inducements are expected to bring a heavy traffic.

THE TRANSIT FACILITIES OF NEW YORK CITY are reported upon by the State Railroad Commissioners for 1897. The report includes the railways of New York city, or the Boroughs of Manhattan and the Bronx. For these the receipts of the various railways for the year aggregated $25,000,000, of which sum $11,500,000 were collected by cable lines and their branches, $3,500,000 by horse-car lines not operated as subsidary to cable companies, and $750,000 by overhead trolley lines; the remainder, or about $9,250,000, represents the receipts of the elevated railway system.

THE BROOKLYN ELEVATED RAILWAY began to run its cars over the Brooklyn Bridge on June 18. As soon as the plans are completed the elevated cars will be propelled by electric motors and cables in crossing the bridge, handled by the bridge employes. The Brooklyn Elevated Co. is to supply the motor-cars and to equip its regular cars with cable-grips and side doors. With both the Brooklyn and the Kings County Elevated railway trains crossing the bridge, many of the regular bridge trains will be taken off; but as the latter system is not yet ready to use the bridge exact arrangements will have to be made later. The Brooklyn Elevated will now run trains direct from City Hall Station to Manhattan Beach and the Sheepshead Bay race track; the Kings County Elevated will perform a similar service for Brighton.

A RECIPROCATING ELECTRIC AIR COMPRESSOR is being experimented with by the Union Railway Co., of New York city. As constructed this compressor weighs 300 lbs. and is 40 × 11 × 11 ins. It makes between 250 and 300 strokes per minute, the cylinder being $3\frac{1}{2} \times 8\frac{1}{2}$ ins. It will pump up a 14 × 36-in. tank to 30 lbs. pressure in 15 seconds. The armature is a straight bar with 36 slots wound with wire and connected to a flat commutator having 46 segments. The armature is nearly square in section and on two sides are placed 16 poles, 8 to a side, which are provided with a single shunt winding. Mounted above the field frame is an arrangement of solenoids and brushes whereby the polarity and position of the brushes are shifted each time the armature reaches the end of its travel. A cut off device is connected with the air reservoir and the motor is automatically stopped and started.

A COMPARISON BETWEEN THE COST OF STEAM and electric power for mill operation in and about the Niagara frontier is given by a Buffalo, N. Y., publication, known as "Greater Buffalo." The article says that 1,000 HP. in Eastern mills can be produced at $25 per HP. per year for 10 hours per day, or $60 per HP. per year considering a 24-hour day, and at this rate 1,000 HP. would cost $60,000 per annum. Electricity is furnished near Niagara Falls for $18 per HP. per year for continuous service. Allowing a loss in the application of 25%, in the case of electricity, and 50% in the case of steam, due to the greater use of belting and shafting, the mill using 1,000 HP. under steam engine conditions would need only 750 electrical HP. This at $18 amounts to only $13,500 against $60,000 for the steam plant, or a saving of $46,500 per year. This sum represents a dividend of nearly 10% on a capital of $500,000.

A CENTENNIAL OF ELECTRICITY will be celebrated at Como, Italy, the birthplace of Volta, from May to October, 1899. It is understood that everything pertaining to the advancement of electricity will be represented. At the same time an electrical congress of the world's prominent electrical engineers will be held. There will also be held at the same time and place a silk manufacturers' exhibition, in which machinery and methods relating to the silk industry will be exhibited. Applications for space or requests for further information should be addressed to the Italian Chamber of Commerce, 24 State St., New York city.

THE CABLE TO GUANTANAMO, CUBA, is now in operation, the Cuban end being on board one of the vessels in the harbor, which is provided with the necessary instruments. It is understood that a station will be established at Camp McCall, thus putting the War and Navy Departments in direct communication with our forces. This arrangement will permit the receipt of a message 15 minutes after sending.

LAYING PNEUMATIC MAIL TUBES ON THE BROOKlyn Bridge is at last under way, and the Tubular Dispatch Co. expects to complete the work within the contract time of four months. Two 8-in. tubes will be placed, a going and a return, through which all first-class mail will be sent. The company will receive $14,000 per year for the service.

THE MUNICIPAL ELECTRIC CONDUITS OF ERIE, Pa., are nearing completion and the committee of the council appointed to formulate rules and regulations is met by the fact that none of the companies will use the conduit except the New York & Pittsburg Telephone & Telegraph Co., and this company only on the condition that no wires with a voltage exceeding 130 be allowed in it. The city engineer claims that he was instructed to draw plans and specifications for low-tension wires only, but councilmen claim that the authority was not so circumscribed.

THE PASSING OF THE CONSTITUTIONAL DEBT limit, by a city, is not always a bar against the payment of money due to a contractor for service performed, says Justice Adams of the U. S. Supreme Court. The case was that of contractor Joseph J. Duffy against the City of Chicago for work done in the land-tunnel for the waterworks. A judgment of $204,000 had been awarded to Duffy and the city appealed on the ground that it was indebted beyond the constitutional limit at the time the contract was made. Justice Adams dismissed the appeal, and conceding that the constitutional limit was passed, said that this fact did not foreclose the subject, as in this case the debt was payable from the water-fund and not from taxation.

THE $11,200,000 LOAN BILL for public improvements at Philadelphia has passed both branches of the city council and been signed by the mayor. Before any of the money can be expended ordinances providing for each improvement must be passed. The largest single item in the bill is $3,700,000 for the improvement of the water supply, of which it is understood that $2,700,000 will be used to start filtration and $1,000,000 for a reservoir for West Philadelphia. About $2,500,000 is to be devoted to street repairs and paving; $900,000 for abolishing grade crossing at the Philadelphia & Trenton Railroad tracks; $600,000 for bridges, and $500,000 for sewers.

FOUR-CENT STREET RAILWAY FARES in Milwaukee cannot be forced from the company by city ordinance, according to the recent decision by Judge Seaman, of the Federal Courts. The Judge holds that so low a rate would be unreasonable in view of the facts in the case.

A LARGE VIADUCT is under construction at Denver, Colo., to connect North Denver with the main city. It crosses the South Platte River and the numerous railway tracks adjacent to the river front. The total length of the viaduct will be 3,480 ft., of which 1,375 ft. will be earth embankment and 2,105 ft. steel construction, the last including two 101-ft. spans across the river. About $[illegible] was spent on this viaduct some ten years ago, but lack of funds caused abandonment of the work. The total cost of the work necessary to complete the structure will be about $325,000. The viaduct will run from Lake St. to Platte St., following the left bank of Cherry Creek most of the way. It will have a 35-ft. roadway paved with asphalt, and two 7½-ft. sidewalks paved with flagstone flagging. The maximum grades will be 4¼%. There will be a number of approaches from the streets near the ends. All the old steel work will be taken down and repainted and worked in with the new material to the best advantage possible. The structure is being built under the supervision of the Board of Public Works. It was designed by Mr. H. S. Crocker, of the engineering staff of the city.

A NOVEL FORM OF PUMPING ENGINE, involving an entirely new principle, is described in the "American Machinist" of June 9, 1898. It is the invention of Mr. C. P. Holst, of Amsterdam, Holland. The pump is designed to avoid the difficulties due to inertia by avoiding the repeated stopping and starting of any part of the water. The water flows in one direction only. In its passage from the inlet to the outlet it passes through four valves, which are attached to and move with the piston-rods. At any instant three of these valves are open, allowing the water to pass through, while the fourth is closed, and, acting as a piston, takes all the work of pushing the water through the pump. This it continues to do for one quarter of a revolution of the flywheel, when it becomes an open valve, and one of the others becomes a piston. The mechanism is highly ingenious. The speed of the pushing valve or piston is almost perfectly uniform while it is pushing the water, and the passages through the pump and valves are of uniform area, so that the velocity of the water through the pump is constant. We have our doubts, however, as to this form of pumping engine coming into extensive use. The present form of large flywheel pumping engine with two or three pump cylinders is a remarkably efficient apparatus, and one hard to improve upon.

MELTED PIG IRON is being used in the basic open-hearth steel furnaces of the Carnegie Steel Co., Ltd., at Homestead, Pa. The first charge was made on June 1 with metal cast into ladles at the Duquesne blast furnaces, five miles distant. The metal is received from the blast furnaces in 15-ton ladle cars, covered with coke dust, transported to Homestead, and poured into a 250-ton mixer and reheater, from which it is poured into 20-ton ladle cars, and from them into the furnace.

THE WILL OF SIR HENRY BESSEMER, just probated in London, fixes the gross value of his estate at only $462,690, of which the net value of the personal estate was $291,085. But the will appears to indicate that he had given away during his lifetime property valued at two or three times as much as the above gross amount. His property is divided between his wife, two surviving sons, Henry and Albert George, and his daughter, Mrs. Elizabeth Wright and her husband. He also provides for the family of Mr. Alfred George Bessemer, and leaves small legacies to servants and several specific bequests to some of the institutions of which he was a member.

THE ENGINEER BRIGADE has established the following recruiting stations, according to a late official order of Gen. Miles: First Regiment, headquarters at New York, with recruiting stations and recruiting officers as follows: Boston, Major J. S. Sewell and Capt. A. Ames, Jr.; New York, Major J. D. Ferguson and Capt. I. A. Shaler; Philadelphia, Capt. E. Ellicott and First Lieut. J. A. Steinmetz; Baltimore, Major L. Duncan and Capt. A. Haviland; Norfolk, Capt. C. P. Breese. This regiment will be mobilized at Camp Townsend, near Peekskill, N. Y., and mustered in by Major J. B. Burbank, 5th Artillery, U. S. A. Second Regiment, headquarters at Chicago; recruiting stations at Springfield, Cincinnati, Indianapolis and Chicago, Major R. H. Savage; St. Paul and Omaha, Major E. L. Pinckard; Denver, Salt Lake City, San Francisco and Portland, Ore., Major W. C. Langfitt. The First and Second Battalion will rendezvous at Fort Sheridan, and the Third at Presidio, Cal. Officers of the regular army are also detailed for mustering in the men at the several stations. Among those who have lately enlisted as privates in the First Regiment are Thomas A. Edison, Jr.; Gustave Ravene, of the American Museum of Natural History; E. W. Stern, M. Am. Soc. C. E.; Edward Erdle, late of the U. S. Coast and Geodetic Survey; Thos. F. Adriance, of the N. Y. Department of Public Works, and a number of others of equal professional experience.

ANNUAL CONVENTION OF THE AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION.

The opening session of this convention was called to order on June 20, only two days after the close of the Master Car Builders' convention, and about the only noticeable difference between the two was a partial change in the personnel of the members present. As for the preceding convention the place of meeting was the Saratoga Theatre. Bishop Newman, of New York, opened the convention with prayer, and business was promptly proceeded with. The address of the president, Mr. Pulaski Leeds (L. & N.) was quite brief and was notable chiefly for the timely criticism it had to offer on the neglect of the members to make use of the scholarships of the Association, and the suggestion looking to the consolidation of the Master Mechanics' and Master Car Builders' associations.

The reports of the Secretary and of the Treasurer showed the balance in bank to the credit of the Association to be $2,214, with all debts paid. The receipts during the year were $3,795.28 and the disbursements were $3,180.16, leaving a balance unused of $555.12. The dues for the ensuing year were made $5, as in the past. After some further routine business the reading and discussion of special committee reports were taken up. The first of these reports was that of the committee on Tonnage Rating for Locomotives, which was presented by the chairman, Mr. G. R. Henderson (Norf. & Wis.). As this report was very long and not adapted to abbreviation, and, moreover, as much the same information in detail has already appeared in print only a few brief remarks will be made here concerning its general character.

Tonnage Rating for Locomotives.

It was found by inquiry that 43 railways in the United States, Canada and Mexico, operating over 66,000 miles of track, were using the tonnage method of rating locomotive performance. Some of these roads had adopted the method 15 years ago, while others had used it only three months, but the average for all roads was possibly two years. The advantages derived were all of the same order, and might be comprehended generally in the following statement:

Heavier average trains hauled with less stalling; more uniform loads and better condition of engines, particularly the tubes, on account of not being overloaded; less engine and more car mileage; less friction between the Motive Power and Transportation departments, and more satisfactory results in every way.

Various estimates of the increase in trains handled under this method were given, which ranged from 10% to 43%, but it is probable that the average will fall between 10 and 20%. The figures, too, came from every variety of road, from level and straight shore roads, and the undulating prairie roads, to the crooked mountain lines of the Appalachian and the Rocky ranges.

The report was discussed at some length by Mr. W. H. Marshall (Chic. & Nown.), Mr. A.E. Manchester (C., M. & St. P.), Mr. Wm. Forsyth (C., B. & Q.), Mr. A. L. Humphrey (Colo. Mich.) and others, but no important information not already familiar to those who have followed the recent extensive discussion of tonnage rating questions was brought out.

The next report was that of the committee on "Best Methods of Boiler and Cylinder Insulation," and it described a series of tests much to determine the insulating efficiency of about a dozen different materials commonly used on locomotive boilers and steam chests, and stationary steam piping. Briefly described the method of making these tests was to wrap a 4-in. pipe with sections of the insulation 12 ins. long, leaving a space of 2 ins. between sections, and on each section to place a reservoir 5⅜ × 10 ins., made of tin with a concave bottom to fit the wrapping. These reservoirs had a surface of radiation of 136½ sq. ins. and held 3½ lbs. of water. A thermometer was inserted in each reservoir to the same depth in the water and then the reservoir was sealed tight. Steam was turned into the 4-in. pipe and readings made on the thermometus every five minutes for about two hours and every ten minutes for about 2½ hours more. The results of these readings were plotted for each reservoir to form a series of comparative diagrams. As these diagrams—as was brought out in the discussion—were evidently erroneous in several respects they are not given.

Further discussion upon this question turned upon the best method of insulating the saddle coating between the boiler and the cylinder and upon the better manner of applying mineral insulation, whether in a plastic or in the sectional form. The advocates of applying the insulation in the plastic form based their preference upon the fact that irregularly shaped parts could be better covered in this manner and that even on regularly shaped parts a closer fit and generally tighter insulation could be thus secured. Those who advocated the sectional form of insulation, on the other hand, claimed that by having the sections or sheets manufactured to fit the parts for which they were designed there was no difficulty in making and keeping the insulation tight, while the air space obtained between the metal and insulation, which was not had when the latter was applied in the form of paste, was an important advantage.

At the close of this discussion the convention took up the discussion of special topics set for the noon hour and afterward adjourned. This topical discussion will be summarized under a single heading at the close of this report of the convention proceedings.

Second Session.

The first business of the second day's session was the reading and discussion of the special committee report on "Square Head Bolts and Nuts; Standards for Pipe Fittings." This committee having been appointed to work in connection with a committee of the Master Car Builders' Association upon a joint report, merely reported progress, and asked to be continued, as did the sister committee which reported at the M. C. B. Convention the preceding week. The discussion following the report was confined to the introduction of the necessary motion and vote to secure the requested continuation of the committee.

The committee report on the "Advantage of Improved Tools for Railway Shops" was then read by Mr. T. R. Browne (Pa. R. R.). The decided need of this investigation and report, if there had been any previous doubt upon its wisdom, was made evident in the opening paragraph calling attention to the backwardness of railway shops in adopting the latest improved tools and methods. A later paragraph calling attention to the inferior methods of machine tool work in railway shops as compared with private manufacturing establishments is equally deserving of attention. The following is an abstract of the leading features of the report:

Advantages of Improved Tools for Railway Shops.

The introduction of truly improved tools for meeting special railway repair shop work has been slow considering the great advantages derived from their use. We are satisfied that a large majority of our Master Mechanics are not reading upon or keeping posted with the progress made by some of their brothers in this important line, or if they are then their managements fail to appreciate their efforts, or to act upon their suggestions. The great improvement made in heavy shop tools and the very successful efforts to introduce features in them for wider scope and greater capacity is familiar to all who have looked into the subject, and your committee assumes in the matter of heavy lathes, planes, slotters, shapers, etc., that all interested are posted, and we propose to confine our report to the more special tools, those designed with a view of dispensing with all work formerly done by hand where possible to machine it. These are the great labor and time savers, and consequently do as much, and in some cases more to reduce cost of repairs on locomotives than the heavy tools and, strange to say, they have received but little attention in proportion to their worth, if we may judge from the lack of general introduction.

Possibly the most important of the improved tools are the latest designs of milling machines. With these we are enabled to machine almost any part of locomotive machinery that cannot be handled in lathes and planers, and also finish and fit parts that could only be done by hand heretofore, and owing to their ease of adjustment we are enabled to design work to be machined by milling very cheaply that would have been difficult, if not impossible, to handle in any other machine. There seems to be no limit to their usefulness, and but few, if any, jobs arise in ordinary practice that cannot be handled in a well designed milling machine. Your committee finds that a saving of at least 20% over the ordinary planer can be obtained where a heavy milling machine is worked up to its full capacity on most work.

Perhaps the next most important, if not equally important adjunct in the way of improved tools for machine shop is the turret lathe. These tools are now made very strong and heavy, designed to cover a large variety of work, and for nearly all kinds of turning from the solid bar. With a properly built turret lathe not only bolts for engine work, but all pins, bushings, collars, etc., for any description of machinery can be rapidly produced, and accurately duplicated. The attachment for threading make them much faster and more accurate than the old method of threading in ordinary lathes. Your committee recommend none but the best and heaviest turret lathes. We find that, with the best designs of turret lathes in the hands of smart and intelligent operatives who adapt the machines to the work in hand, and work them to full capacity, a saving of from 45% to 55% can be obtained in all kinds of bolt and pin work, over the ordinary methods of doing this work in lathes.

Your committee finds that great improvement has been made in the machinery for handling brass work in shops, and shops that are prepared, or desire to make their own oil cups, gage cocks, and standard brass fittings would do well to look into the matter. Many of the best of these machines will lessen the cost of production of this class of work at least 50%, and the output is far superior in fit and finish owing to the arrangements for accurate duplication. There are now available several makes of quick return high speed planers and shapers for light work, and where a shop is confined to two or three planers, all of them probably 36 ins. or over with one or more heavy shapers, one of these machines will be found most probtable. They handle rod keys, liners, keys for frames, etc., and for quick time on brass work of all kinds, are indispensable. These newer designs are small, but heavy and compact, and should not be confounded with the flimsy little machines so generally on the market, with which all shop men have become disgusted, owing to poor design, extreme lightness and uncertainty of feed.

Your committee is pleased to find that where compressed air is being used in connection with the best motors for drilling, reaming, boring, tapping, chipping, calking, screwing in stay bolts, riveting tanks, ash pans, and many other uses, that the average saving over the old hand methods is from 35 to 40%, and on some jobs, is over 50%, particularly in drilling shops where ratchets were formerly used. The average saving in boiler shops fully equipped with good pneumatic tools to cover all lines where they have proven an advantage is about 50%. We find fewer improvements in our blacksmith shops than in other departments of railroad works.

Outside the shop proper, in the yards and buildings for storing material, scrap iron, etc., there is a great field for saving labor by conveniently arranged pneumatic lifts and motors. In addition to the saving in time, the liability to accidents to employees is greatly lessened by the safer and surer manner of handling and the fewer men employed.

We find a great improvement in many of the wood-working machinery departments of our railroads. The improvement in planing and matching machines, borers, mortisers, sawing machine, and in fact all wood-working machinery, has been so rapid in the past few years as to raise the question "whether it would not pay many roads to dispense with the whole of their antiquated old plant and replace it with just half as many well selected tools designed for their work, that would turn out more work in a day than they now get out in a week. Before concluding our work on this subject, we desire to call the attention of our association to a few things that have struck us most forcibly while inquiring into the matter:

First. The great difference existing in the methods of prosecuting work even on our improved tools in the average railroad shop, as compared with a well organized, and hustling manufacturing establishment in about the same line of business. The factory producing for the market to make a profit seems actuated throughout by a different impulse from the average railroad shop, even where piece work has been long established, and none of the railroad shops seem able to get quite as much advantage from their special improved tools as is accomplished in the factories; in other words, they are not worked up to their capacities as continually. We have, of course, made due allowance for the difference actuating the employees, and the difficulties to be met by the foremen, and others in our railroad shops, and we simply mention this in connection with the economy of improved tools.

Second. In some shops we found milling machines that were idle which could have been well adapted to many kinds of work, which was being done in planers, shapers and slotters. No pains should be spared to provide every device for utilizing the milling machine to its fullest capacity and keeping it going all the time. When once realized, its great usefulness cannot be overlooked, and its place is never filled by any other machine.

Among other improved tools that seem to contribute largely to the increased output of such shops as have taken advantage of them is the cold sawing machines. These are used for cutting to given lengths all kinds of shapes, round, squares, flats and ovals of almost any section, evening up channels, tees, angle irons, etc., and also cutting them to given lengths, with great ease and rapidity as compared to old methods. These machines are almost indispensable in the building of iron and steel tender frames, trucks, etc., and for the boiler maker they supply a long felt need. None but the heaviest and best should be introduced. A reasonable estimate of their saving over old methods is about 35 to 50%, according to character of work to be done.

We have not touched upon shop cranes as yet, and we almost hesitate to do so, as so few ordinary repair shops are able to provide them. At the same time we all admit the desirability of their extended use. A large majority of the older shops are so arranged as to prevent the use of overhead traveling cranes, but the introduction of electric motors has made it possible where the change can be afforded for some of our railway shops to erect them. Where this cannot be done, the work can be greatly facilitated by putting up at needed points the best forms of chain hoists in connection with pneumatic lifts, etc.

The discussion following this report was very brief. Mr. F. F. Gaines (Lehigh Valley) called especial attention to the value of the milling machine for certain kinds of work. In an actual test, made by him, to compare the efficiency of a milling machine and a planer in cutting key ways in shafts, it was found that the former would do double the amount of work of the latter. Mr. J. Wade Hibbard (Sibley College) urged the need of railway shops endeavoring to attain to the more hustling methods and greater efficiency of the contract shop, or manufacturing plant. He also wished to confirm what the report had said concerning the great usefulness of the milling machine.

The next report considered was that of the committee upon the "Efficiency of High Steam Pressure for Locomotives," which was read by Prof. Wm. F. M. Goss (Purdue University). This report is printed nearly in full elsewhere in this issue. The discussion which followed was quite active, but it branched off into boiler and firebox design, cost of repairs, valve design, and a variety of topics not germaine to the subject.

The last of the special committee reports to be considered at this session was that on "Best Form of Fastening for Locomotive Cylinders." This report was signed by two members of the committee and was accompanied by a supplementary report by the third member which dissented from the report proper in several particulars. About 30 illustrations accompanied the two reports, and as these and the accompanying text cannot be abstracted to good advantage, while the subject is of too special a character to make a full reprint of general interest, the report is not given here. Those who desire to study the report in detail can secure copies from the Secretary of the Association. The discussion following the report was very brief.

As during the preceding day the noon hour was devoted to the discussion of special topics which will be summarized under a separate head in our next issue. In the afternoon an excursion was provided by the Delaware & Hudson R. R. to Schenectady, N. Y., where the shops of the Schenectady Locomotive Works and those of the General Electric Co. were visited. In the evening a lecture entitled "The Training of Air Engineers," illustrated by about 60 stereopticon views, was delivered by Prof. W. F. M. Goss, of Purdue University, at the Saratoga Theatre.

MEETING OF THE AMERICAN SECTION OF THE INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS.

A meeting to organize the American section of the International Association for Testing Materials was held at the Engineers' Club of Philadelphia, Pa., on June 16, in response to a notice sent out by Mr. Gus C. Henning, M. Am. Soc. M. E., the American representative of the council of the International Association. In calling the meeting to order Mr. Henning explained the aims and objects of the association and its methods of operation in detail. The minutes and pro-

ceedings of the foreign meeting were considered and various resolutions were examined. The following were elected officers of the American section: Chairman, Mansfield Merriman; Vice-Chairman, Henry M. Howe, Secretary, R. L. Humphrey; Treasurer, Paul Kreuzpointner. Prof. Henry M. Howe and Dr. R. G. G. Moldenke were made additional American representatives of the general council.

It was explained that individuals or committees were to be appointed to consider the various problems, the results of their deliberations to be presented at the next local meeting to be held August 15 or 30, when these reports will be considered, and, if deemed worthy, will be sent to the grand council. This body will examine the reports, and if considered of sufficient importance they will appear in the official organ, which will be printed in English, French and German.

The problems so far named number 23, and at the last international meeting were referred to international committees. In each case the United States is entitled to from 2 to 6 members. The problems of general engineering interest are as follows:

On the basis of existing specifications, ways and means are to be sought to establish international standard specifications for the inspection of iron and steel.

Determination of methods of testing the homogeneity of iron and steel looking to their eventual use for inspection.

Preparation of uniform methods of testing paints as a protection against corrosion of railroad structures.

The formation of a uniform system of tests for tile pipes.

Standard consistency for mortars for test briquettes; determination of conditions which will produce approximately similar density of tension and compression briquettes.

Investigations of the effect of sulphurous acid on artificial stone and on mortars.

Investigation of effect of H_2S gaseous form and dissolved in water on mortars.

Investigation of metals under abnormally low temperatures.

Methods of testing welds and weldability.

Collection of masses of material for preparation of standards for "piece tests," with special reference to axles, tires, car springs, cast and wrought-iron pipes, etc.

Investigation of the most practicable method of polishing and etching for micrographic study of wrought irons.

Artificial and natural building stones and their bond materials; study of relation of chemical composition and weathering qualities of such stone; methods of determining the weathering qualities or properties of slate.

Determination of rapid methods for determining conditions of constancy of volume of hydraulic bond materials.

How can hydraulic bond materials be tested rapidly for their strength?

Testing and evaluating the resolutions of conferences relating to the determination of adhesive power of hydraulic bond materials.

Examination of propositions for the uniform determination of the value of puzzuolanas as mortars.

Investigation of causes of abnormal behavior of cements, as to time of setting.

The effect of fecal matter on the strength of hydraulic bond material.

Completion of tests of effect of salt water on the strength of hydraulic bond materials.

How can inspection of lumber insure against growth of fungi?

Determination of fundamental methods for testing lubricants.

ANNUAL CONVENTION OF THE AMERICAN WATER-WORKS ASSOCIATION.

The eighteenth annual convention of the association was held at Buffalo, N. Y., June 14 to 16, inclusive. About 220 members and guests were present. The meeting was called to order on Tuesday by the president, Mr. John Caulfield, Secretary of the Water Board of St. Paul, Minn. After the usual address of welcome the address of the president was read. The speaker traced the connection between public water supplies and civilization. He also stated that during the year the association had subscribed to a number of legal publications, containing digests of decisions, and that the secretary had abstracted some of those relating to public water supplies. The abstracts have been printed in pamphlet form, and may be had by application to the secretary, Mr. Peter Milne, Assoc. Am. Soc. C. E., 96 William St., New York city.

The secretary reported the membership on June 1, 1897, as 355, divided as follows: Honorary, 1; active, 286; associate, 68.

"Some Information."

The first paper read was by Mr. F. A. W. Davis, of Indianapolis, and was given the general title "Some Information" because it treated of a number of different subjects. The author first presented brief analyses of the latest available financial reports of the water-works of Buffalo, Detroit and Minneapolis. In the light of these figures he thought the cities named would not be able to maintain their present extremely low water rates without having deficits. He had no disposition to criticise the business methods of these cities, but he should await the outcome with interest, especially as water is constantly appreciating in value, owing partly to the need of purification.

The Indianapolis Water Co., of which Mr. Davis is Vice-President, is now covering a reservoir 1,000 ft. in length and having an average width of 50 ft., the widest portion being about 70 ft. wide. The covering consists of yellow pine boards 3½ ins. wide, resting on joists about 2 × 12 ins. The joists rest in turn on 6-in. wrought-iron pipe, placed horizontally and supported by 4-in. cast-iron pipes for columns.

"Furnishing Water."

A paper with the above title was read by Mr. Wm. Himrod, of Erie, Pa. It was mostly made up of incidents relating to complaints regarding the quality of the water at Erie in years past, and experiences with meters. The water supply is now satisfactory, a large new cast-iron intake pipe having been laid a few years ago. (See Engineering News, Dec. 5, 1895.) The books of the water department of Erie are so kept that it can be known how each account stands at the close of each day.

"Some of the Early Methods of Collecting, Storing and Distributing Water."

This paper was by Mr. Wm. R. Hill, M. Am. Soc. C. E., of Syracuse, N. Y. It was wholly historical in character but full of interesting and curious information.

"Water Meters and Rates."

Mr. John B. Heim, of Madison, Wis., presented a paper in which he set forth in the most convincing manner the great benefits derived from the meter system in his city. The actual saving in fuel in ten years, attributed to reduced consumption caused by meters, has been $16,893, or 44% of the investment for meters. The average cost of coal has been $5.25 per ton. The meter rates are on a sliding scale, ranging from $2 per 1,000 cu. ft., or about 27 cts. per 1,000 gallons, downwards. There is, apparently, no minimum meter rate, and every consumer pays the maximum price for the first 5,000 cu. ft.

Mr. Jas. H. Harlow, M. Am. Soc. C. E., of Pittsburg, said that the records of the Wilkinsburg Water Co., which supplies a portion of Pittsburg and some outlying territory, show that of 1,000 metered customers not 65% use 6,800 cu. ft. of water per year, which amount must be paid for whether used or not, and 10% used not over 2,800 cu. ft. a year. He thought 5,000 cu. ft. a year a proper basis for a minimum rate. Until his company began to filter its supply, about 33% of the meters stopped each year. (The water is taken from the Allegheny River. A filter crib has been placed beneath the river to clarify the water. (See Engineering News, April 28, 1898.—Ed.) Mr. Harlow believed that not over 80% of the water passing meters is registered, and that none of the last part of a water closet flush is registered. He was in favor of using smaller meters than are generally used for domestic service. The test for accuracy he believed to be very important. This his company makes in the form of a time test. A domestic meter should register 0.1 cu. ft. when flowing in so small a stream as to require about 75 seconds to pass the meter. By using a storage tank Mr. Harlow believed a family could get all the water it needed free of cost, drawing the water in so slow a stream that the meter would not register it.

Mr. Hill said that in Syracuse, in 1897, there were 4,200 families whose total use of water did not exceed the minimum rate of 3,000 cu. ft. per year for $5. A rigid inspection of ball valves of water closets is necessary to prevent waste.

Mr. Dow R. Gwinn, of Peoria, stated that his company used a 1-64-in. aperture in testing meters for accuracy.

Mr. P. D. Wanner, of Reading, Pa., said that from the tenor of the discussion it was evident no one present was opposed to meters. The order of the day seems to be, first filter, then meter. He had long maintained that the price of meters is too high.

"Experience with Vegetable Growth in Ground Water."

Mr. Owen T. Smith, of Freeport, Ill., next described the experience of that city with crenothrix. This organism forms in the suction pipe connected with his driven wells so it can be pulled out in handfuls. The pipe is cleaned with a steel brush. It imparts a brown color to the water and is said to be due to the sesquioxide of iron in the water. The water is exposed to neither light or air before the growth takes place. He asked those present to suggest a remedy. The only apparently sound advice offered was to the effect that he find a water without the iron. Much discussion followed, but it was on algae growths in general, instead of on crenothrix.

Filtration and Aeration at Lexington, Ky.

In this paper Mr. S. A. Charles, of Lexington, described the water purification plant of his company. (See Engineering News, May 28, 1896, and Jan. 14, 1897.) Mr. Charles took exception to the statement on p. 200 of Hill's "Public Water Supplies," to the effect that the use of a coagulant is dangerous to health, owing to the passage of some of the coagulant into the water. An analysis of the filtrate from his plant showed no coagulant. The high amount of 15 to 20% of raw water is used for washing at Lexington, but this water is not wasted. The approximate cost of filtering 1,500,000 gallons a day at Lexington is as follows:

Loss of sand	$0.30
One man	1.50
170 lbs. sulphate of alumina	3.40
3,500 lbs. coal	3.50
Repairs, none yet, but estimated	.30
Total	$9.00
Per 1,000,000 gallons	$6.00

The temperature of the water is lowered 16° during the process of filtration and aeration. Most of the drainage area is used for grazing purposes. The country there is of a limestone formation.

"Specifications for Cast-Iron Water Pipes."

This paper was by Mr. P. D. Wanner, of Reading, Pa., who is connected with a number of water companies in Pennsylvania and also with the Reading Foundry Co. The author disapproved the long, detailed specifications put forth by some cities, urged that the long ton is a nuisance, must be specified to be legal, and is not used by the railways in making up freight charges; he also disapproved of requiring bidders to submit their bids on printed forms, to accompany their bids by checks, and was in favor of lower bonds than are usually required. As to engineering features, Mr. Wanner's ideas were inclined to leave rather more to the foundryman than is generally done in what has been considered the best practice hitherto. This will be best illustrated by the discussion, as follows:

Mr. Emil Kuichling, M. Am. Soc. C. E., said that the specifications called for pipe of uniform thickness, which is an impossibility. This impossibility should be recognized and a definite range of variations stipulated. In from 4 to 10-in. sizes of pipe the eccentricity should not exceed 1-16-in., and for sizes over 10 ins. it should not exceed ⅛-in. Mr. Wanner leaves the relative amounts of coal tar and dead oil to be used for coatings to the judgment of the contractor, which is objectionable. The speaker had been trying for years to get the right composition for coating. He would challenge any one to deny the statement that corrosion or tuberculation would take place in 8 to 10 years.

Mr. H. F. Dunham, M. Am. Soc. C. E., of New York city, said that in any pile of pipe in a yard corrosion could be found six months after it had been coated.

Mr. Wanner replied to the above that he was more interested in cast-iron pipe as an owner of water-works than as a manufacturer of pipe. He had simply put forward what he believed to be right and just after 20 years of experience. The coal tar used of late has not been as good as formerly, because it is not produced in this country. It may be imported, and the imported tar may be mixed with the home product, but only a little of the latter may be used in proportion.

"Compensating Reservoirs in Lieu of Compensation for Riparian Rights and Its Legal Aspects."

Mr. S. E. Babcock, of Little Falls, N. Y., first defined in this paper the rights of riparian owners in the water of running streams. In England it is common for authorities taking such water for public supply to build compensating reservoirs instead of paying damages to riparian owners. This practice is in accordance with an act of Parliament. At Little Falls a compensating reservoir has also been built, and a large saving effected over what would probably have been fixed as damages under condemnation proceedings. This was done, however, under private contract, and after the city had bought some riparian rights and had obtained some advantage over the owner of the principal remaining one.

Mr. Babcock presented figures of stream flow under maximum, average and minimum conditions, and also a line of argument designed to show that if only a sufficient storage capacity were provided to keep the stream up to its normal, dry weather capacity, riparian owners could demand no more. He also cited one American case where the court held that the diversion of flood water was not a ground for damages.

Mr. Kuichling said he had been unable to find any law or lawyers which would recognize English practice or common law, or common sense in this matter. In England it is all fixed by an act of Parliament. The New York Court of Appeals has just handed down a decision in which it refuses to recognize a compensating reservoir of ample capacity as satisfying damage claims.

Mr. F. W. Cappelen referred to a case brought against the city of St. Paul where the U. S. Supreme Court rendered a decision which seemed to uphold Mr. Babcock's ideas.

Mr. Kuichling urged further that a general rule or law was not easily applicable here. A paper mill in Rochester had put in machinery to use about five or six times the ordinary flow of the Genessee River for some two or three high water months in the year, during which time they could make pulp to be stored and used the remainder of the year. Mr. Babcock replied that there would still be a large quantity of flood water available for storage and that it was utterly impracticable to build a power plant large enough to use the full flood flow of a stream.

Mr. Wanner stated that he read a paper on this subject at the Minneapolis convention of the association and that since then the Pennsylvania Water-Works Association has done much good work in support of the principle, helping to obtain a favorable court decision.

"Pipe Coatings."

A report from the Committee on Pipe Coatings was submitted by Mr. F. W. Cappelen, of Minneapolis. He stated that about 70% of the manufacturers of cast iron were using the Angus Smith formula for coating and that the others were mixing the coal tar and oil in varying proportions. They had not heard of the use of asphalt for cast-iron pipe, while coal tar is barred from use on steel. The dif-

ferent asphalt coatings were then described and mineral rubber coating like that used on the Minneapolis steel pipe line was recommended. The committee advised that the report of a similar committee of the American Society of Municipal Improvements be included in the proceedings, some of the members being common to both committees. The convention voted to do this, and also to continue the committee.

"A Method of Introducing Service Pipes Without Trenching."

This system was described by the inventor and patentee, Mr. G. T. Latta, of Ludlow, Ky. It is a process of hydraulic tunneling, on a small scale, water being forced under pressure through a wrought-iron pipe with a cutter on the end, the water returning on the outside of the pipe, bringing the dirt with it. The pipe and cutter is oscillated by hand in light material and by means of a spool and block and tackle in heavy material. The water is taken from the street main, after it has been tapped and the ferrule inserted. If the pressure is too low a hand force pump may be used. The return water is bailed out of the hole as necessary. The lead service should be inserted while the tunnel is wet. Of course two excavations are necessary, one at the street main and the other at the sidewalk line. At Ludlow, 85 services have been put in by this method, 57 ft. being the longest one, but a tunnel 114 ft. long has been bored. The expense is much less than the cost of trenching.

"Free Water for Private Baths."

Mr. L. N. Case, of Detroit, prefaced this paper by remarking that it was suggested by a statement in some periodical that if private bath tubs were made free there would be no necessity for municipal bath houses. He stated that the first cost of installing a bath tub is a far greater obstacle than the yearly water supply for such a tub, and that for the class of people whom it is desired to reach by means of free water for private baths it would be quite as necessary to provide an inclination to bathe as a tub and water without cost. Someone, of course, must foot the bill, and under the system of water charges generally in vogue some water consumers would be required to pay more for their water in order that others might have water for nothing.

"An Oil Filter for Boiler Feed Water."

A paper on this subject was read by Mr. Dabney H. Maury, Jr., M. Am. Soc. M. E., of Peoria, Ill. It is printed, with illustrations, elsewhere in this issue.

"Method of Cleaning Reservoirs."

Mr. Dow R. Gwinn, of Quincy, Ill., described the cleaning of a reservoir 246 × 343 ft. at the bottom and 25 ft. deep. The reservoir is used for storing filtered water and before cleaning the bottom had become covered with mud to an average depth of 9 ins. The inlet and waste pipes were at corners diagonally opposite. The inlet valve is 20 ins. in diameter and requires 196 turns to open. The gate was opened 12 times and the mud was washed to the waste pipe by means of the resulting stream, which was confined to channels about 8 ft. in width, formed by placing plank on edge. These were supported by nailing triangular-shaped boards for braces, onto the plank, this bracing being reinforced where necessary, by driving stakes in the puddle bottom of the reservoir. The writer suggested that U-shaped iron clamps, ½-in. thick and 6 ins. wide, might be used with advantage to hold the ends of the plank together. The 2,000 cu. yds. of mud in the bottom of the reservoir were removed in eight days at a total cost of 15 cts. per cu. yd., of which about 10 cts. was for labor and the balance for material, including plank and rubber boots. The cost of the water used was not included. The mud was loosened by means of wooden shovels, similar to snow shovels. The best dimensions for the blades was found to be 8 × 18 ins.

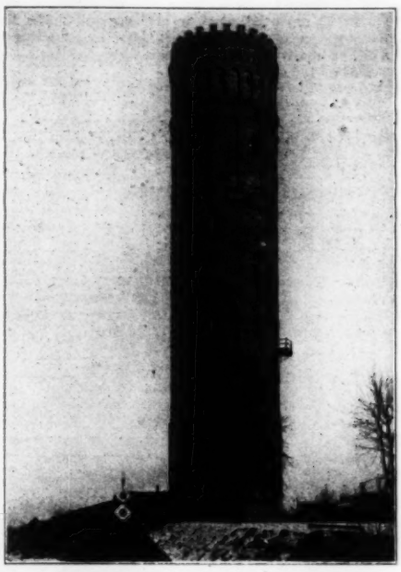
"Legal Responsibilities of Water Companies for Loss of Life by Drowning in Their Reservoirs."

A letter was read from Mr. E. S. Wills, of Atchison, Kan., stating that he was unable to be present. He stated that while some boys had been trespassing on the reservoir property of the company one of them, 14 years of age, fell in and was drowned. A jury had just given a verdict for $1,000 damages against the company. The case will be appealed. Several members expressed the opinion that the verdict would not be sustained, owing to the fact that the boy was trespassing. Mr. Milne said that the courts had three times thrown out a suit for damages for drowning in one of the Brooklyn reservoirs, where some men were crossing in a boat to shoot ducks on an island in the reservoir. The court held that the men were trespassing.

"A Stand-Pipe and Its Brick Casing."

Mr. W. H. Laing, of Racine, Wis., described the method employed to enclose an elevated stand-pipe at Racine, and submitted the full specifications for the work. The stand-pipe is of wrought iron, 25 × 90 ft., giving a capacity of about 330,000 gallons. It rests on a monolithic concrete pedestal, extending 55 ft. above the ground. The foundation of the pedestal is 37 ft. in diameter and 7 ft. deep. The pedestal is 26½ ft. in diameter and consists of a central core 10½ ft. in diameter and an annular ring 4 ft. thick, leaving a space of 4 ft. between the two. The ring and pedestal are joined together by arched floors, the upper one being 4 ft. thick at the crown of the arch.

The stand-pipe was built 12 years ago. The first winter it was in use a cake of ice, at one time 12 ft. thick, formed in the pipe, filling nearly the whole pipe for this depth except for a 6-in. space at the outer edge. To prevent sudden increase in the pressure on the pumps, a 6-in. hole was bored vertically through the ice. For fear the ice would wreck the pipe when it began to melt in the spring, on account of being attached to the ladder, the ladder rivets were



View of Brick Masonry Enclosed Stand-Pipe at Racine, Wis.
L. H. Bacon, Boston, Mass, Architect.
Wm. H. Laing, Superintendent Racine Water Co.

cut on the outside of the stand-pipe, thus allowing them to pull through. The holes thus formed were stopped by means of pine plugs. When the ice finally went down in April no harm was done except to break the ladder, which was afterwards completely removed. Large quantities of ice formed in subsequent winters, but did no harm.

The bottom of the stand-pipe was anchored to the concrete. It was thought that the wind caused too much strain on the anchor bolts. In view of the possible dangers from both ice and wind it was finally decided to enclose the stand-pipe with brick masonry. The work was finished on Nov. 15, 1898, with Mr. Frederick Graham, of Racine, Wis., as contractor. The plans for the casing were drawn by Mr. L. H. Bacon, an architect of Boston, Mass. The scaffolding used was entirely secured by bolts. The stand-pipe is covered by a roof. The accompanying view of the completed structure shows it to be unusually pleasing from an architectural point of view.

"Municipal Franchise Contracts."

This paper was presented by Mr. H. E. Keeler, of the National Tube Works, Chicago. The author urged that franchises should be clearly drawn and protect both parties. Water rates should become lower as time goes on and should be based on local conditions. The city should reserve the right to buy out the company. In case of purchase the city should pay the first cost, plus a contract profit of say 20%, together with interest on the investment and some compensation for the previous risks involved and for a business already developed. From this sum should be deducted the net earnings of the plant and the amount charged to depreciation and to profit and loss. The first cost should be determined at the time of construction and the books of the company should be open to the city for the determination of this sum. Public regulation of the rates would be proper, if based on the cost of the plant, with a fair allowance for profits. Companies ought to be given such advantages incident to public ownership as exclusive franchises and no taxation. The author deplored the attempts made by many cities to harass private companies, notably by trying to lower their rates, even when definitely fixed in the franchise. No matter, in such cases, if the franchises or contracts are iron clad, the companies are sometimes caused much trouble and expense to demonstrate that fact in the courts. The author said that he is interested in a company which supplies water in a territory recently annexed to Chicago. The contract fixes the rates, notwithstanding which fact the Chicago City Council recently passed an ordinance providing that hereafter the rates charged by the company should be no higher than those charged by the city of Chicago. The lower court has sustained the ordinance, and the company has appealed the case.

Mr. Milne stated, in discussing this paper, that the U. S. Supreme Court has recently decided that a contract between a city and a company is tangible property. From this he argued that the earning power of a franchise should be considered in fixing the value of works as fully as the mains or pumps.

Mr. Gwinn said that when a city wishes to get possession of the works owned by a company it does not propose arbitration, but a competing municipal plant. Pennsylvania is the only state whose courts have declared this course illegal, and there the lower courts upheld it. Montana passed a law providing that a city must buy out a private company before building works, but the state courts have held that law unconstitutional.

Mr. Wanner again urged that the private water companies of the several states should organize associations to protect their interests. He said it was wonderful what could be done in this way if proper methods were pursued. Surprisingly good results had been obtained in Pennsylvania. Mr. S. J. Rosamond, of Fort Smith, Ark., said that in the West and Southwest reliance could not be placed in the state courts, so the water companies were being forced in self-protection to incorporate in other states, reorganizing, if necessary, in order to have their legal cases brought, in the first instance, in the U. S. Courts.

This led several members to state that private water companies could not get justice in the lower courts, especially in jury trials. Mr. W. J. Milner, of Birmingham, Ala., cited an instance where water was shut off a house for 24 hours by mistake. A jury awarded $100 damages on this account. Here the judge intervened by setting aside the verdict and the case is still unsettled.

"A Note Concerning Mechanical Filtration."

This paper, by Prof. Wm. P. Mason, of Troy, N. Y., was illustrated by lantern slides. The speaker first aimed to show that the settling tanks placed beneath certain types of mechanical filters serve as reaction chambers, permitting the complete decomposition of the alum. The water and alum being admitted to the tank at the bottom and at one side, and passing out at the top and center, has a circular motion and deposits large quantities of flocculent hydrate of alumina in a flat cone-shaped mass on the bottom of the tank. This material is very light. The process removes a large percentage of the bacteria of the applied water. Analyses show that in the closed pressure filters the alum is not entirely decomposed until the water has passed quite a depth down into the sand. In other words, time, as would be expected, is an important element in the chemical reaction.

Business and Pleasure.

Wednesday forenoon was given up to business. The executive committee recommended that the action of the secretary in not printing monthly or quarterly pamphlets, giving legal decisions, as instructed at the last convention, and his printing instead one pamphlet of this sort during the year, be approved. It stated that it had invested $1,000 in a U. S. bond of that amount. It recommended that the salary of the secretary for the year just closed, and for the coming year, be fixed at $600 per year. The recommendations were adopted. The principal officers elected for the year 1898-9 were: President, J. A. Bond, Wilmington, Del.; Secretary and Treasurer, Peter Milne, Assoc. Am. Soc. C. E., 96 William St., New York city. On Thursday morning, after a spirited contest between the advocates of Detroit, Mich., and Columbus, O., as the next place of meeting, Detroit was chosen. On Wednesday afternoon there was a most enjoyable excursion by boat to Chippewa, Ont., just above Niagara Falls, then by trolley down the Canadian side of the river to Queenston, thence across the river by ferry to Lewiston, N. Y., and up the gorge railway by trolley to Niagara Falls, N. Y. Here the power station of the Cataract Construction Co. was visited and also the mechanical filter plant of the Niagara Water-Works Co. On Thursday afternoon the Buffalo fire department gave an exhibit of fire streams from the special fire pipe lines before the afternoon session of the convention. The business of the convention was practically closed on Thursday evening, but not so its pleasures, for on Friday there was an all-day excursion to Syracuse, with a luncheon, drive and banquet. These courtesies were extended by the citizens of Syracuse, through Mr. Wm. R. Hill, M. Am. Soc. C. E., Chief Engineer and Superintendent of the Syracuse Water-Works.

ANNUAL CONVENTION OF THE MASTER CAR BUILDERS' ASSOCIATION AT SARATOGA, N. Y.

First Session.

The first session of the 32d annual convention of this Association was opened at 10 a. m., June 15, 1898, the place of meeting being the Saratoga Theatre, Saratoga, N. Y. Bishop Newman, of New York, offered prayer and was followed by Mr. A. P. Knapp, President of the Village of Saratoga, who welcomed the convention to the village. Mr. Ashley W. Cole, Chairman of the Board of Railroad Commissioners of the State of New York, who had been invited by the Association to deliver the opening address, spoke at some length in review of the work which was being done by legislation in the way of securing the use of automatic couplers, power brakes and other safety appliances, and gave great credit to the Master Car Builders' Association for placing these devices upon such a basis that legislation of this kind had been possible without fear of error. The courteous expressions of the various outside speakers were suitably answered by Presi-

dent S. A. Crone, of the Association, and others, and the convention proceeded at once to the consideration of its routine and special business.

The first matter on the program was the address of President Crone, who spoke briefly of the important part just now being played by the railways in the work of mobilizing the army and transporting ordnance and supplies, and then followed with a number of recommendations in regard to the future work of the Association in its own particular branch of railway affairs. Briefly summarized the more important of the recommendations made were: that the by-laws be changed to provide that the opening day of the annual convention should be the second Wednesday in June, instead of the second Tuesday; that the constitution be changed to admit one railway commissioner from each state, upon application, to associate membership during his term of office, such application to be voted upon at the session during which it was received; that a test of M. C. B. couplers be adopted as "recommended practice" as is now done with respect to car axles; that instructions be formulated for loading and securing on railway cars of block stone and rails; that in cases where the interiors of freight cars are damaged by the lading, such as acids, oils, etc., the railway controlling such lading be held responsible, except where special cars were furnished by owners; and that the question whether the dummy coupling should be continued as "recommended practice" or not be submitted to letter ballot for decision. In closing President Crone referred to the important work done by the Association in the past, and urged that equal vigilance and industry were necessary in handling the questons which the future would bring up.

The report of the Secretary showed the Assocation to have a total membership of 447 members representing 1,247,795 cars. During the year since the last convention the receipts of the Association were $9,700.40 and the disbursements $7,551.02, leaving a balance of $2,149.38, which, added to the balance previously on hand, made a sum of $8,245.61 now in the hands of the Treasurer, with no outstanding debts. The dues for the coming year were made $4.

After some further routine business the convention proceeded to the consideration of the reports of Standing Committees.

Reports of Standing Committees.

Although three of the seven reports presented by the standing committees of the Association were postponed as coming more appropriately with the proceedings of the second day's session, they are all as a matter of convenience in arrangement included under this heading of the first day's proceedings.

Supervision of the Standards and Recommended Practice of the Association.—This report enumerated all of the standards and methods of "recommended practice," giving under each the changes or modifications recommended, if any. Altogether 17 changes were recommended, and upon vote of the convention these changes were ordered to be submitted to letter ballot for adoption. The report further recommended five subjects in connection with the Association's standards which the committee thought it desirable to have investigated and reported upon by special committees at future conventions. These last recommendations were referred by vote of the convention to the Committee on Subjects for further consideration.

Triple Valve Tests.—The chairman of this committee, Mr. G. W. Rhodes (C., B. & Q.), made a verbal report, in which he stated that no triple valves had been sent to the committee to be tested, and that consequently no tests had been made. Mr. Rhodes referred very pertinently to the fact that this same neglect to make any use of the committee and through it of the Association's excellent facilities for making these important tests was true of the previous year during which the committee had been in existence, and he strongly urged the necessity of reform. He called attention to the necessity of having freight trains equipped with power brakes by Dec. 31, 1899, which the Federal safety appliance law imposed upon the railways, and, therefore, of railway officials obtaining as soon as possible a knowledge of which ones of the various triple valves on the market fulfilled the conditions of the law and of the standards of the Association.

In the discussion which followed Mr. Rhodes' remarks a number of the members supported what had been said, and after some slight dissent it was voted that the committee be ordered to make as soon as practicable tests of the various makes of triple valves now on the market, and to draw up a list, by makers' names and catalogue number, of both those which fulfilled and those which failed to meet the proper requirements. This list was to be submitted to the Executive Committee of the Association, which would make it known to the members of the Association as soon as practicable. In some respects this was one of the most important actions taken by the convention during its sessions.

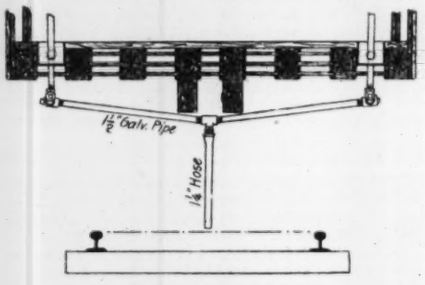


Fig. 1.

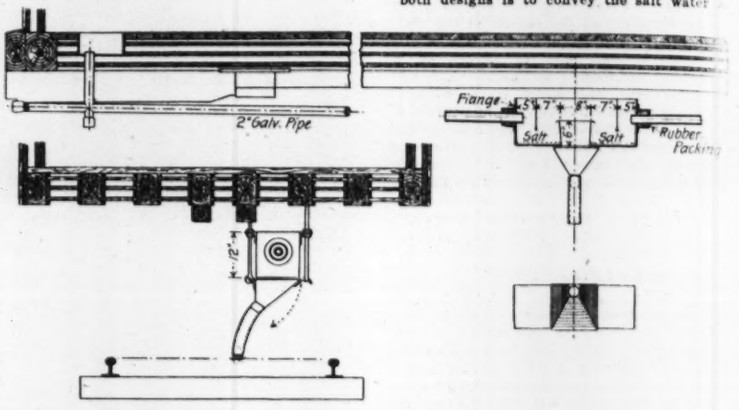


Fig. 2.

RECOMMENDED DEVICES FOR DISPOSING OF SALT WATER DRIPPINGS WITH LEAST INJURY TO TRACK AND STRUCTURES.

Standard Wheel and Track Gages.—This committee reported that unforeseen circumstances had prevented tests which it proposed from being made during the year, but that such tests would be made at an early date and that a full report would be presented at the next convention.

Brake-Shoe Tests.—The chairman of this committee, Mr. S. P. Bush (P. C., C. & St. L.), stated that so few new brake-shoes had come out during the year that the committee had not considered it worth while to institute another series of tests, and consequently none had been made. He also announced that the elaborate brake-shoe testing machine belonging to the Association had been transferred from the Westinghouse works to the laboratories of Purdue University, where it would be kept in repair and held ready for the use of the Association at all times.

Conference with Auditors.—This committee was appointed at the 1897 convention of the Association to recommend a plan for simplifying bills and accounts after conferring with a committee of the Railway Accounting Officers' Association, and its report contained the recommendations which grew out of this conference. Upon vote of the convention the report was referred to the Executive Committee for consideration and this committee advised that the recommendations be not concurred in. The standing committee upon this subject was then dismissed by vote of the convention.

The reports of the two remaining standing committees on "Arbitration" and on "Prices in Master Car Builders' Rules," referring exclusively to the Rules of Interchange, were adopted in part, only the portions adopted being incorporated in the revised Rules of Interchange.

Special Committee Reports.

Only one of the reports of special committees was considered during the first day's session; namely, that on "Rust from Salt Water Drippings."

Rust from Salt Water Drippings.

This subject was brought up prominently during the topical discussions at the convention of 1897, and excited so much interest that it was made the topic for investigation and report by a special committee consisting of Mr. S. Higgins (Lehigh Valley) and Mr. A. M. Waitt (L. S. & M. S.). It should be understood that salt water drippings come from refrigerator cars. In such cars the mixture used for cooling purposes consists of ice and salt, the proportion of the salt to the ice varying from 6% to 11%, and one car will produce about 200 gallons of salt water or brine every 24 hours, which brine will, on the average, contain about 8½% of salt. The injury to rails and rail connections and to metal bridge floors by the corrosion caused by these drippings is sometimes very great, and frequent complaints are made by the maintenance of way and bridge departments of railways on that account. Comparatively little damage seems to be done to car trucks and other metal work of the cars themselves. The work of the committee was therefore taken up with the needs of the permanent way department chiefly in view, and the result is summarized in the following excerpts from its reports:

The committee started out with the idea of having refrigerator cars fitted with one or more reservoirs, to be attached underneath the car body, into which the salt water drippings could be conveyed, the reservoirs to be large enough so that they would not have to be emptied more than once every 12 hours, at division terminals where proper provision could be made for taking care of the salt water. This idea, however, met with so much opposition on the part of the refrigerator car owners that the committee abandoned it, not caring to recommend an arrangement that the refrigerator car owners would be unwilling to adopt.

The committee presents two methods that can be followed without much expense, either one of which will improve the present condition of affairs although a patent has been applied for in the case of the second design (Fig. 2), it is the opinion of the committee that this design will give the better results. It would be more expensive, but will not cost to exceed $5 each, including a royalty, if the patent is granted. The principle of both designs is to convey the salt water drop between the rails, at about the center of the track, where it will do little or no damage. In fitting up a refrigerator car with either type of attachment, care should be taken to provide caps or plugs at proper points, so that the pipes can be readily cleaned out, and galvanized iron piping should be used, in order to resist the corroding action of the salt water or brine in passing through it.

The discussion which followed this report was very brief. Several members quoted experiences substantiating the statement of the committee that salt water drippings were annoying sources of injury to all permanent way and track structures of metal which were reached by them, and disproving the frequent claims of refrigerator car owners that the injury resulting from such wastes was so trivial that it might be neglected. It was finally voted that the first design (Fig. 1)—this design not being subject to claims for patent rights—should be submitted to letter ballot as recommended practice of the Association for constructions of this nature.

Second and Third Sessions.

As a provision of the by-laws makes the consideration of the Rules of Interchange a special order of business at 10 a. m. on the second day of the convention, only about an hour of the early morning session was available for other work. Attention was turned first to the report of the committee on "Trains Parting; Extent and Causes of Breakage in Two with Automatic Couplers and the Remedy." At the convention of 1897 a report on this subject was presented, in which it was recommended that further investigation be made as to the limit of safe wear that may be allowed in knuckles and couplers, with the view of recommending to the Association some practical method for inspectors and others to use in determining when these parts become worn or distorted beyond the limit of safe service. It was this additional work that the present committee had in charge, and it was with considerable disappointment that the announcement was received that no report had been prepared. Some very pertinent remarks were, however, made upon the subject by Mr. G. W. Rhodes (C., B. & Q.) and Mr. A. M. Waitt (L. S. & M. S.), which are presented nearly in full as follows:

G. W. Rhodes—I believe there is an under-current of feeling among our members that there is hardly a more important subject than this one to be dealt with by railways. I judge of that because of the discussions, and in the recommendations for committees. We find there is a tendency to discuss questions all of which relate to trains parting. It is true that the accidents to freight trains have been largely reduced and there are fewer deaths than we have had in the past; nevertheless, accidents do occur. I was told not long ago that although we very seldom have any accidents on our road, the one that most frequently occurs is the break-in-two. A couple of years ago, at our convention, it was voiced quite largely that break-in-two's were very serious, and I believe it behooves us to consider what we are doing to prevent the break-in-two's from occurring, let us say, as seldom as they do occur now.

I think that one move that has been made by one of the prominent coupler companies is to be highly commended. The price of the product has been reduced to such an extent that there is no longer any incentive for any new companies to enter the field. Again, these older companies in their replacement prices in place of only taking back their own material, take back any material which is made in the form of an M. B. C. coupler. I think that is one of the most commendable improvements

that the manufacturers of couplers have made. It at once draws to their attention the character of the material which some of the newer coupler companies are trying to impose upon the railroads. Some years ago a loud protest was made at our convention because some railways had put into service cast-iron knuckles, and we introduced a clause in our rules to prevent that, and to show that we discountenanced that kind of material. I have recently seen an M. C. B. coupler put in service made of cast-iron—the bar itself, and not the knuckle.

I do not hesitate to say that any railroad or manufacturing company which will put M. C. B. cast-iron bars into service, and from which loss of life results, has committed a criminal act. I propose, for one, if anything of that kind is discovered on the equipment of cars passing over our road, to make my discovery of it as prominent as possible. I think that is what we should do as members of the Association. If anybody, through ignorance or any other cause, attempts to put material on the cars which is not suited for the purpose, which pass all over the lines of this country, we must make prominent that negligence and that criminal indifference to the safety of railroads, trainmen and passengers on our lines.

Now, let us ask what we can do in this respect. In the first place, a movement has been made at this meeting for specifications for draw-bars and couplers. Now let us all get at that with some intention of having some kind of specification. Let us ask ourselves—how can we have a specification for wheels and specifications for axles and at the same time have no specification for a coupler.

In getting over other lines there will occasionally come up conditions which we cannot control. For instance, some neighbor may have a C., B. & Q. car which gives him trouble, and the coupler comes apart. The superintendent of the connecting road may say that he cannot control that car. There is one thing he can do; he can write to the motive power department of the Burlington road and explain to them that such and such a break-in-two occurred on his road with cars fitted with such and such couplers. When we have done that and given that information, generally I believe we will finally know the couplers which cause break-in-twos; the kind of draft rigging that cause break-in-twos, and in following this case up we will have material aid in knowing what is the best kind of coupler to use and the best kind of attachments to use; and I would urge the members of the association to follow this thing up closely. We cannot afford to have devices in use which are not reliable. Trains are now run at high speeds, and the connection between them must be safe regardless of the interests involved in the devices.

Mr. A. M. Waitt: I am sorry that the committee made no report for I think that the subject is of vital importance to the railroad companies. It seems to me, as the Association has found it wise to have a permanent committee on triple-valve tests and a permanent committee on brake-shoe tests, that the subject of couplers would come right in line for permanent committee work. I would like to see a standing committee of the Association appointed to take this subject up and consider it broadly. With 50 or 100 different makes of M. C. B. couplers at the present time, it is necessary to ask whether we can afford to be dealing with so many kinds and styles of couplers of all degrees of efficiency in working and of all degrees of quality of material that is used. I hope that one of the results of this convention will be to see a permanent committee in connection with this line of work and if we should wish to carry on official tests in the year to come, there are institutions like the Purdue University which I think will be glad to assist us. During the last year I think it is safe to say that many of the coupler companies have carried out some of the suggestions made last year by the committee on trains parting, and have made improvements in couplers and avoided some of the weaker points that were at times causing trains to part.

The question is asked whether it is necessary to have any additional device in order to prevent trains parting. We know that one of the causes in some couplers is some sort of gripping action that raises the lock and lets the knuckle open. That evidently must be caused by the cars not being kept at a uniform distance apart, sometimes slacking up and sometimes pulling apart. With our heavier capacity cars it seems to be a proper question whether or not we have need to make some provision to keep the cars steady and keep them from having the lateral and longitudinal motion that they now have by means somewhat similar to what we have and find necessary in our passenger trains. Our consideration was given last year and is still being given to the use of some sort of buffing device—something to keep the cars where they should be and preventing the breaking of couplers by the unusual shocks in switching. There are various devices in use, and I believe as the capacity of the cars and the length of trains are increased, we must consider this matter very seriously.

There is one point especially which I think must be given attention this coming year, and that is in deciding on some limit for permissible wear in the couplers. On many roads which are equipped with automatic couplers, the couplers will come apart without uncoupling many times. We have investigated a number of cases of this unlocking, and we have found some of the causes. I have a blue print made recently which gives the contour line of the standard M. C. B. coupler and the contour line of an M. C. B. coupler which uncoupled a number of times on one of the divisions of our road and in our yard. We had it removed from the car and made a careful diagram showing the exact shape of it. (Mr. Waitt exhibited a diagram, which showed that on account of wear and the distortion from some cause or other of the guard arm, the opening between the knuckle and guard arm was more than 1 in. greater than it should be.—Ed.) This coupler unlocked four or five times in going over the road without the knuckle opening, and they were coupled again just as easily. As a suggestion to whatever committee may take the matter up, I think that we must limit the amount of distortion or bending of the guard arm; limit the change in the position of the knuckle by means of wear by locking the back of the knuckle; limit the thickness of the tongue of the knuckle in wear and the amount of wear in the knuckle pivot and pivot point. All of these are vitally important if we are going to keep our couplers in shape and keep the cars coupled together securely and safely.

Immediately after these remarks the committee took up the work of revising the Rules of Interchange and a number of minor changes were made in the various rules. As these changes are of particular interest only to those having to do with the interchange of cars they will not be given here. One phase which the discussion assumed, however, is important to mention, since it resulted in the appointment of a committee to consist of two members from the East, two members from the West and one representative of private car companies to investigate and report upon the advisability of allowing railways west of the 105th meridian a differential in charging for car repairs under the rules. The representatives of the Western railways made a vigorous fight to secure this advantage at this session but were unable to carry their point. Some of the more valid arguments presented both for and against the question will be referred to in our editorial columns next week.

Fourth Session.

At the fourth and last session the consideration of special committee reports was resumed and pushed vigorously. The first of these to be taken up was that on the "Care of Journal Boxes."

Care of Journal Boxes.

The method of procedure adopted by this committee was to send a list of questions covering the various phases of the subject to the different railway motive power officials of the United States, and the report contains these questions and the answers received in full. The general tenor of the replies received, together with the opinions of the committee, were, however, pretty completely summarized at the conclusion of the report as follows:

(1) A large majority recommend high grade oil for car lubrication.

(2) But few use cooling compound, and most all consider it unnecessary in connection with car oil boxes.

(3) That woolen waste is preferred by a substantial majority over cotton waste, but two are now experimenting with a waste of wool and foreign material, which they claim is superior to woolen.

(4) It is the unanimous opinion that there is no material known that is a practical substitute for waste for journal-box packing, a large majority recommending woolen as the best, and your committee is of the opinion that the above majority represents the views of a majority of the members of this convention. The committee calls attention to the fact that two members are making tests, but are not ready at present to recommend, and also to the fact that several of the members recommend woolen waste with a percentage of asbestos mixed with it as being better than woolen waste.

(5) That a large majority recommend that waste be soaked between 24 and 48 hours before using, and at a temperature of about 65° F., and your committee is of the opinion that waste should be soaked at least 36 hours at a temperature of not less than 70° F.

(6) That for all practical purposes the members almost unanimously recommended the common wooden dust guard so generally in use at the present time, and your committee concurs in that recommendation.

(7) That while there is considerable difference of opinion, as indicated in the replies, existing in the minds of the members as to the best oil-box lid, all seem to desire a lid that will keep the oil from getting out of the box and the dust from getting in, the preference expressed being for the so-called Fletcher lid first, with the McCord second.

(8) That the members regard the matter of careful packing as being one of utmost importance, their replies indicating that their careful attention has been given to the subject. They are particular to have the waste soaked thoroughly at least 24 hours, packed firmly, yet not tightly, care being taken to see that the waste does not come up to the bottom line of brass within ⅛-in., and your committee fully endorses such practice.

(9) That the members very generally consider it good practice to shake out the old and discard the worn-out short waste, mixing the good old waste after soaking with the new, the only difference of opinion being as to when and how often it is necessary to do this. The committee is of the opinion that it is good practice, and should be done at least once a year, and the date of repacking stenciled on the truck. It further recommends it should always be done with the removal of oil boxes or change of wheels, and also in shop practice, when there is any indication that the waste has in a degree become matted or partially worn out.

The discussion of this report was opened by Mr. A. M. Waitt (L. S. & M. S.), who referred to the fact that the statement made in the report that the number of hot boxes per 1,000 car miles averaged 2½ showed a decided need of reform in the care of journal boxes. In exceptional instances it was possible that such a large number of hot boxes might be entirely normal, but in the majority of cases there was no justification for such a condition of affairs. On the Lake Shore & Michigan Southern Ry. hot boxes were a subject of constant attention on the part of the Motive Power Department, and the good results of this careful watching seemed to be shown by the fact that in passenger service this road averaged only one hot box for every 70,000 car miles, and in freight service one for every 20,000 car miles, and 80% of these were on foreign cars. Every hot box of sufficient importance to cause delay or accident was reported upon and the proper action taken to avoid repetition. One of the most prolific causes of hot boxes was dust, and there was a crying need for something better than the common crude wooden dust guard to keep the dust from the back end of the journal boxes. He had found that much trouble was saved in the matter of hot boxes by removing at the approach of cold weather the packing saturated with the light oils used in summer and replacing with waste saturated with heavier oil for winter use. The light oil congealed in cold weather and failed to lubricate the journal properly. The saturated waste which was removed was pressed to relieve it from the oil, and this oil and such parts of the waste itself as were fit were preserved for further use.

Mr. F. W. Brazier (Ill. Cent.), concurred in Mr. Waitt's remarks concerning dust guards, but called attention to the fact that the great cost of most special devices of this kind as compared with the common wooden guard precluded their adoption by most roads. He had found the most satisfactory preventative of hot boxes to consist in repacking with saturated waste in place of the ordinary method of simply pouring a new supply of oil into the front end of the box.

Mr. Pulaski Leeds (L. & N.), on the other hand, was disposed to believe that packing, oiling, dust, etc., were being made the scapegoats often for trouble due to poor brasses and imperfections in the journal bearings and boxes.

The next report on the programme was that on "Square Bolt Heads and Nuts and Standard Pipe Fittings," and on behalf of the committee Mr. C. A. Schroyer (Chic. & No'w'n) reported so far all that they had been able to do was to receive the co-operation of the Master Mechanics' Association, the American Society of Mechanical Engineers and the various manufacturers in appointing committees to confer with the M. C. B. committee upon this subject. The committee therefore asked to be continued another year, when a full joint report would be presented to the Association. The convention voted that the request of the committee should be granted.

Specifications for Air Brake Hose.

In the matter of arranging subjects for the present convention it was decided at the convention of 1897 that better results could be secured in some instances by assigning the topic to a member for treatment in the form of an individual paper instead of by having the usual committee investigation and report. Mr. A. M. Waitt (L. S. & M. S.) having already given much study to this subject, it was therefore allotted to him.* As an exhaustive study of the air brake hose question the paper is probably the best thing in print, and any one who may be interested will do well to secure a copy. The length and special nature of the paper precludes the publication here of anything except the final conclusions in the form of "Recommended Specifications:"

Recommended Specifications for Air Brake and Signal Hose.—(1) All air brake and signal hose must be soft and pliable, not less than two-ply nor more than four-ply.

(2) The tube must be hand-made, composed of not less than two calenders of thin rubber; it must be free from holes, or imperfections in joining, and must be so firmly united to the cotton fabric that it cannot be separated readily without breaking or splitting the tube. The tube must be of rubber, of such composition and so cured as to successfully meet the requirements of the stretching test given below. The tube must not be less than 1-32 in. thick at any point. It may preferably be made in composite form, with a complete inner tube of 1-16 in. rubber wrapped with a single wrapping of 8-oz. cotton canvas, the whole being covered with an outer tube of 1-32 in. thick rubber.

(3) The canvas or woven fabric used as wrapping for the hose to be made of good quality cotton, loosely woven, and to weigh not less than 22 oz. per yard, and to be from 38 to 40 ins. wide, except when woven with a seamless tubing. The wrapping must be frictioned on both sides, and must have in addition a distinct skimming coat or layer of gum between each ply wrapping not less than 1-32 in. thick. The friction and coating must be of the same quality of gum as the tube. The canvas wrapping to be cut and applied on the bias.

(4) The cover must be of the same quality of gum as the tube, and must not be less than 1-16 in. thick. The cover may preferably be made in composite form in the same manner as provided for with the tube. In this case there must be not less than 1-32 in. thickness of rubber between the outer ply of wrapping and the 8-oz. duck forming part of the cover, and there must be an equal thickness of rubber on the outside.

5. Air-brake and signal hose are to be furnished in 22-in. lengths. Variations exceeding ¼-in. above or below this length will not be accepted. The inside diameter of all such hose to be not less than 1¼ ins. nor more than 1 5-16 ins., except on the ends, which are to be enlarged to 1 7-16 ins. for a distance of 2¾ ins., the change from large to smaller diameter to be made tapering, so that inside of hose will be practically smooth. The outside diameter must not exceed 2 ins. nor be less than 1⅞ ins. in the main part, or exceed 2 3-16 ins. or be less than 2 1-16 ins., at the enlarged ends. Hose must be finished smooth and be regular in size throughout, as above indicated; ends of hose to be capped with from 1-16 to ⅛-in. of rubber. Caps must be vulcanized on, not pasted or cemented.

6. Each standard length of hose must be branded with the name of the manufacturer, year and month when made, and the standard railroad mark, and also have a table of raised letters at least 3-16 in. high, to show date of application and removal. All markings except the road mark may be combined in one plate. All markings to be full and distinct, and made of a thin layer of white or red rubber vulcanized on, and so applied as to be removable only by cutting with a knife or sharp instrument.

7. Air-brake and signal hose will be subjected to the following tests: Each hose must stand a proof pressure test of 300 lbs. without failure of any kind. With every lot of 200 or less shipped to one point, the manufacturer must furnish free of charge one additional hose for test. From each such lot one hose will be taken at random, and subjected to the following tests in the order named:

Bursting Test.—The test hose must stand a hydraulic pressure of 500 lbs. before bursting, and must not expand more than ⅛-in. in diameter under a pressure of 100 lbs.

Friction Test.—A section 1 in. long will be taken from any part of the hose, and the friction determined by the force and time required to unwind the hose, the force being applied radially. With a weight of 25 lbs. suspended from the separated end, the separation must be uniform and regular, and when unwinding the average speed must not exceed 6 ins. in 10 minutes.

Stretching Test.—A 1-in. section of the rubber tube or inner lining will be cut at the lap or thickest part. Marks 2 ins. apart will be placed on it. The 1-in. strip will next be stretched until the marks are 10 ins. apart, and then released immediately. The piece will then be remarked as at first, and stretched to 10 ins., or 400%, and will remain stretched 10 minutes. It will then be released, and the distance between the marks measured 10 minutes after the release. In no case must the test piece break from defective

*A paper on this subject by Mr. Waitt was published in Engineering News of April 21, p. 264.

quality of rubber, or show a permanent set of more than ¼-in. between the 2-in. marks. Small strips taken from the cover and friction will be subject to the same test.

8. If test hose fails to stand the required tests, the lot from which they are taken will be rejected without further examination. If test hose are satisfactory, the entire lot will be examined and those complying with the requirements herein set forth will be accepted.

There was practically no discussion of the paper, and the next subject, "Springs for Freight Car Trucks," was taken up at once.

Springs for Freight Car Trucks.

The report stated that standard springs to be desirable must be designed to satisfy the following conditions:

(1) The springs must be generally applicable to the majority of the existing cars without expensive alterations in their application.

(2) They must be so designed that they will not increase the cost of maintenance by premature failure or excessive first cost.

(3) There should be a minimum number of different coils, and the different coils should be so made as to be readily distinguished one from the other, so as to prevent confusion and mistakes in application, and to reduce the cost of stock necessary to be carried for prompt repairs to both foreign and individual cars of usual design.

(4) All coils used for outside bars to be wound right-handed, and the inner coils to be wound left-handed, to prevent interlocking.

The standard coils recommended for adoption were as follows:

Spring A.—5 ins. diameter, 5-16-in. diameter steel, 5⅜ ins. free height; to carry 3,500 lbs. at 5 ins.; weight, 10¾ lbs.

Spring B.—3 1-16 ins. diameter, 9-16-in. diameter steel, 5⅜ ins. free height; to carry 1,150 lbs. at 5 ins.; weight, 4 lbs.

Spring C.—7 ins. diameter, 1 5-16 ins. diameter steel, 7 ins. free height; to carry 8,000 lbs. at 6 ins.; weight, 24½ lbs.

Spring D.—4¼ ins. diameter, ⅞-in. diameter steel, 7 ins. free height; to carry 4,500 lbs. at 6 ins.; weight 9½ lbs.

Spring E.—7½ ins. diameter, 1⅛ ins. diameter steel, 7½ ins. free height; to carry 11,000 lbs. at 6½ ins.; weight, 32 lbs.

Spring F.—4½ ins. diameter, ⅞-in. diameter steel, 7½ ins. free height; to carry 5,000 lbs. at 6½ ins.; weight, 12½ lbs.

Except that some of the members asked for further explanation upon some points of the report there was no discussion and the convention proceeded to a consideration of the paper on "Thermal Tests for Car Wheels," by Mr. S. P. Bush (P., C., C. & St. L.). This paper is abstracted elsewhere in this issue. There was no discussion. The report on "Air Brake and Signal Instructions" was the next on the program. The object of this report was to recommend revisions to be made in the standard "Instructions" of the Association, and a large number of minor changes were suggested which were of too little general interest to be given here. Upon vote of the convention it was decided to submit the recommendations of the committee to letter ballot for adoption.

Steel Car Framing.

At the convention of 1897 the committee upon this subject submitted five different individual designs for steel underframing for freight cars. At the close of the discussion which followed it was decided that a new committee should be appointed to study the question further with the purpose of harmonizing, if possible, the different designs of the old committee and recommend one or perhaps two designs which should embody the most desirable features brought out both in the report and the discussion which followed it. The work of this new committee was outlined in this report, which summed up the results as follows:

The members of your committee believe that at the present time it is impossible to design a steel car frame which will meet with universal favor. The extremely limited experience had with steel cars up to date is alone a sufficient reason for recommending the postponement of the selection of a design at the present time. Your committee recommends that it be discharged and that the steel car question be considered by another committee of this Association about four years hence.

Accompanying the report the committee presented general, and, for the most part, incompletely dimensioned, designs of a Pennock steel hopper ore car of 80,000 lbs. capacity, a Pennock steel flat car of 80,000 lbs. capacity, a Pennock steel gondola car of 80,000 lbs. capacity, a Schoen steel double hopper gondola car of 100,000 lbs. capacity, a Harvey steel box car of 80,000 lbs. capacity, a Barr's steel underframe for flat car of 60,000 lbs. capacity, a Sanderson's steel underframe for box car of 60,000 lbs. capacity, a Norfolk & Southern steel flat car of 60,000 lbs. capacity, a Great Northern Ry. steel box car of 60,000 lbs. capacity, a Fox Pressed Steel Equipment Co.'s steel flat car of 100,000 lbs. capacity and a Fox Pressed Steel Equipment Co.'s gondola car of 100,000 lbs. capacity. These eleven designs, in connection with the five presented by the previous committee, were thought to represent very fully the status of the steel car at the present time. There was no discussion upon the report and the committee was discharged.

The next report was that of the committee upon "Passenger Car Pedestal and Journal Box for 4½ × 8-in. Journal." At the convention of 1897 this committee presented a design for a standard pedestal for 4½ × 8-in. journals, the drawings of which were published in Engineering News of June 17, 1897. The committee was continued at the request of the Committee on Standards with instructions to recommend designs for a journal box and contained parts for a 4½ × 8-in. journal. In the report this year detail drawings for such a journal box were given, but as these drawings contained a number of draftsman's errors they are not yet reproduced here. The corrected drawings will be published in the final proceedings of the Association.

After the consideration of some routine unfinished business the convention took up the report of the committee on subjects for the convention of 1899, and then proceeded to the election of officers. The subjects recommended were as follows:

(1) Standard specifications for lumber in freight car construction.
(2) Best design of freight car door-fasteners.
(3) Standard application of air-brake appliances with a view to reducing the number of couplings in pipes.
(4) Best method of applying running-boards and ladders to freight cars.
(5) Committee to report on the advisability of allowing a differential or fixing prices for repairs done on work west of the 105th meridian.
(6) Perfection of top-hinged oil-box lids, so as to more completely exclude dust from journal boxes.
(7) To recommend standard journal boxes 3¾ ins. by 7 ins. and 4¼ ins. by 8 ins., adapted to use with the pedestal type of freight car truck.
(8) To define length and spread of guard arm, and to consider the devising of a safety limit gage for determining when M. C. B. couplers and knuckles are worn beyond a limit of safety.
(9) To revise the recommended practice of loading poles, logs, bark and other structural material on cars.
(10) To report specifications for M. C. B. couplers.

The following were the officers elected: President, Mr. Charles A. Schroyer, Superintendent Car Department, Chicago & Northwestern Ry., Chicago, Ill.; First Vice-President, Mr. John T. Chamberlain, Superintendent of Motive Power, Boston & Maine R. R., Boston, Mass.; Second Vice-President, Mr. J. J. Hennessey, Master Car Builder, Chicago, Milwaukee & St. Paul Ry., West Milwaukee, Wis.; Third Vice-President, Mr. W. J. Robertson, Master Car Builder, Central Vermont R. R., St. Albans, Vt.; Treasurer; Mr. G. W. Demarest, Master Car Builder, Northern Central R. R., Baltimore, Md.; Executive Committee, Mr. E. D. Bronner, Assistant Superintendent of Motive Power, Michigan Central R. R., Detroit, Mich., Mr. J. H. McConnell, Superintendent of Motive Power and Machinery, Union Pacific Ry., Omaha, Neb., and Mr. Wm. Apps, Master Car Builder, Canadian Pacific Ry., Montreal, P. Q.

Topical Discussions.

The constitution of the Association makes the presentation and discussion of questions propounded by members a special order of business for the noon hour of each day of the convention unless otherwise ordered, and during the noon hours of the first and last days of the meeting about a dozen questions of this character were considered. For the most part these subjects excited very little discussion aside from the remarks of the members appointed to introduce each one. A brief review of only the more important remarks, therefore, will be given here.

Timber Specifications for Freight Cars.—This subject was introduced by Mr. Puluski Leeds (L. & N.), who outlined a set of specifications covering timber for framing, roofing and siding, which were drawn with the end in view of securing standard dimensions of timber used in our framing. In support of this last proposition Mr. Leeds said:

I hope there will be a discussion upon the desirability of standard dimensions for all material constituting the framing of a car. If we could get widths and thickness uniform, the length would not be so essential, although desirable. In my opinion, all cars of certain classes should be uniformly framed. By doing this not only would we get the benefit in repairs of foreign cars without delay, but when specifications were issued (as they frequently are) calling for all lumber and timber to be seasoned on the stick for at least six months, and at the same time calling for delivery within 60 days, they will not be so apt to call up a derisive smile, inasmuch as manufacturers could then not only stock up for seasoning and take advantage of the market, but they could well afford to build and keep standard cars in stock, and when offered a contract of which early delivery was the essence they would only have to letter well-seasoned cars, instead of having to pick the buds and leaves off the "seasoned" timber, which is usually put into cars for prompt delivery.

It will be noted from the list of subjects for the 1899 convention given above that Mr. Leeds' remarks bore fruit in having the subject of timber specifications for freight cars suggested for a special committee report for next year.

Standard Trucks for 60,000-lb., 80,000-lb. and 100,000-lb. Cars.—A paper of some length was presented on this subject by Mr. E. D. Bronner (Mich. Cent.). The author stated that standard trucks for 60,000-lb., 80,000-lb. and 100,000-lb. cars had an alluring sound, but whether it will be possible to adopt them was another question. Judging from past experience he thought (1) that the association could not agree upon a standard and that even if it adopted a "standard practice" it would not be much used; (2) the adoption of a standard would amount to very little in the end, as the practical result sought could be largely accomplished by the adoption of standard parts for trucks; (3) a standard adopted and fully recognized would impede progress. Investigations made by him had shown that the parts of trucks, which had to be repaired most often were: wheels and axles, journal bearings, journal boxes and covers, journal bearing wedges, and journal box bolts. These parts had already been standardized for several classes of trucks and if they, together with the cross sections of arch bars and column bolts, could be made standard for 60,000-lb., 80,000-lb. and 100,000-lb. trucks the Association would obtain all it could ever hope to in the present stage of the car builders' art. Practically also, this was all that was necessary.

The second phase of the topic was the relative efficiency of metal trucks of various forms as compared with each other and with the diamond truck, considering cost of maintenance, effect on wheels and journals, and safety. He considered a plate truck of the type represented by the Fox, Cloud and Hewitt trucks to be the most efficient truck for cars of large capacity. Properly designed and built in a proper manner, with the right material, they retained their shape in service and by cushioning the entire structure above the journal boxes decreased the cost of maintenance. A rigid body bolster, however, was of fully as much importance as a rigid truck bolster, and a wooden body bolster could no more be kept in line than a wooden truck bolster.

Best Arrangement of Air-Brake Testing Plant for Large Terminal Points.—This subject was treated by Mr. H. F. Ball (L. S. & M. S.), who described briefly a testing plant recently installed by his company near Buffalo, N. Y. The following is a brief abstract of the description:

Air is compressed by a duplex compressor having 8 × 8 in. and 4¼ × 8 in. cylinders into a storage tank of 100 cu. ft. capacity, located in the open air and within 30 ft. of the compressor. A 2-in. main feed pipe conveys the air from top of storage tank to a point opposite the repair yard, from which point branch feed pipes 1¼ in. in diameter convey the air to the branch lines on the repair and inspection tracks. Four branch lines of 1¼ in. pipe, having connections spaced 50 ft. apart, complete the equipment for six repair tracks. The branch lines are located midway between the tracks, pipes and connections being secured in place on top of the planking.

In the inspection yard 14 tracks are taken care of by seven branch lines of 1¼-in. pipe. Each line of pipes furnishes air for two tracks. It is laid on top of ties as close to the rail as practicable, and is held in place by ⅝-in. wrought staples driven into the ties. Connections, consisting of 1-in. Westinghouse couplings threaded at one end and screwed into 1-in. cut-out cocks and connected to tees in line pipe by 2¼-in. nipples, are located at a distance of 100 ft. apart. Each connection is enclosed in a box shaped casting, the top and end of which are hinged and pivoted, forming a lid.

An expansion arrangement is provided every 300 ft. This consists of two short sections of 1¼-in. air brake hose connected together at one end by hose nipples, elbows and a union, and the opposite ends connected with the line pipe by hose nipples and elbows, the whole forming a U bend in the line. The expansion arrangements are enclosed in a manner similar to the hose connections. All pipe used in the plant is extra heavy galvanized pipe. At the junction of the branch feed pipes with the branch lines on the inspection and repair tracks valves are provided, so that in case of necessity any one of the branch lines may be cut out and not interfere with the working of the remainder of the plant.

The location of pipe on top of ties close to rail, and the detail arrangement of hose connections above described, would seem to commend themselves from the standpoint of economy in installation and maintenance. In the plant above described we have about 23,000 ft. of pipe, the storage capacity of which represents approximately 2,700 cu. ft. The inspection tracks are provided with 200 connections. A plant of the above description, with connections, boxes, etc., located as described, can be installed for about 15 cts. per lin. ft., exclusive of compressor and storage tank.

Defective Top Wedge Construction of M. C. B. Journal Boxes.—The discussion of this topic was also opened by Mr. H. F. Ball (L. S. & M. S.), who said in part:

The top surface of the present M. C. B. key is in the shape of a cylindrical segment, the radius of the curve being 78 ins. When the journal box is in its normal position it is in contact with the key of its center, and load which it supports is distributed uniformly lengthwise of the journal. Any necessary adjustment between the box, key and brass by reason of truck imperfections, is obtained by a rocking motion of the box on top of the key. It follows that an adjustment obtained in this way necessarily implies an eccentricity of bearing between the box and key, resulting in increasing the unit of pressure at one end of the journal, and to such an extent at times as to interfere seriously with proper lubrication.

In the examination of trucks that have been in service for some time it will be noticed that a large percentage of the boxes are inclined out of the vertical. In most cases it will be found that the tendency of the box is to incline outwardly at the bottom, throwing the load towards the rear of the journal.

In pedestal type of trucks this condition is very noticeable from the excessive wear which takes place between the pedestals and box guides at top of box. A further evidence of the want of uniformity in the distribution of the load is seen in the unevenly worn bearings which are removed from time to time. It is well known that the rear end of the journal is the most difficult part of the journal to keep properly lubricated, owing to the tendency of the packing to shift out of position, and also to the amount of grit and sand that is carried in the rear of the box. Add to these obstacles to proper lubrication the excessive bearing pressure at the rear end of brass, and we have a combination at work that sooner or later gives the inspector an opportunity to send in a report of a hot box, resulting from a "doubtful" cause. What is desired is a key or brass that will adjust itself to the inequalities of the truck, and at the same time maintain a uniform distribution of the load lengthwise of the journal. This condition cannot be obtained with the use of the present M. C. B. standard key.

Durability of Paint Applied by Compressed Air.—The question as to whether paint applied to cars by compressed air spraying machines is as durable as paint applied by brush has, as the readers of Engineering News knows, been pretty thoroughly discussed at recent meetings of railway car painters, and the remarks of Mr. F. W. Brazier (Ill. Cent.), who presented the subject, brought out little that was unknown. As far as the experience of the Illinois Central R. R. has gone, and it has made a large use of compressed air painting, Mr. Brazier stated that paint applied by this method seemed to be fully equal in durability to hand painting, and perhaps superior.